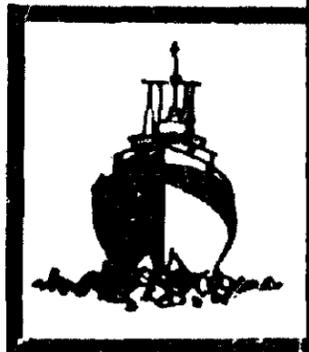
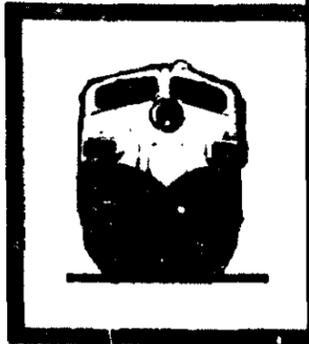
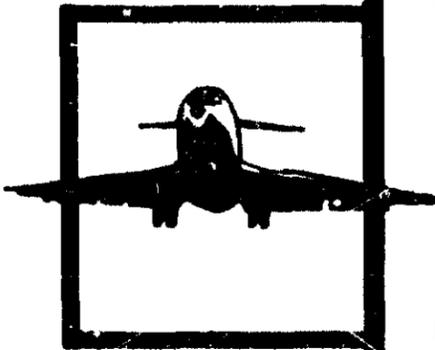


PB82-910411



NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

AIRCRAFT ACCIDENT REPORT

**EMPIRE AIRLINES
FLIGHT 141, PIPER PA-31, N546BA
ITHACA, NEW YORK
JANUARY 5, 1982**

NTSB-AAR-82-11

UNITED STATES GOVERNMENT

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<p>16. Abstract</p> <p>On January 5, 1982, Empire Airlines Flight 141, a scheduled commuter flight between Utica, New York, and Washington, D.C., crashed while attempting an approach to Tompkins County Airport, Ithaca, New York, an en route stop. The flight crew had contacted Elmira approach control and had received instructions for an instrument landing system (ILS) approach to runway 32 at Tompkins County Airport.</p> <p>About 0740 e.s.t. the copilot declared an emergency stating that the airplane had a landing flap problem; he later stated that only one flap was down. He also stated that they were not able to maintain altitude and that the airplane was descending. Elmira approach lost radar contact with the airplane about 0741 e.s.t.; the last radio transmission from the flight was recorded about 0745.</p> <p>The airplane crashed in a wooded area near three suburban residences. The pilot and copilot, the only persons aboard, were killed. There were no injuries to personnel on the ground. The airplane was destroyed by impact and postimpact fire.</p> <p>The National Transportation Safety Board determines that the probable cause of the accident was excessive wear of the left flap motor/flexible drive spline and certification of the airplane with a flap system that did not meet the requirements of Civil Air Regulation 3.339. The worn spline caused a split flap condition of 34° that resulted in marginal flight control authority. Moderate low altitude turbulence and transient low level wind shear may have contributed to the upset and loss of control.</p>					
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WASHINGTON, D.C. 20594**

AIRCRAFT ACCIDENT REPORT

Adopted September 22, 1982

**EMPIRE AIRLINES FLIGHT 141
PIPER PA-31, N546BA
ITHACA, NEW YORK
JANUARY 5, 1982**

SYNOPSIS

On January 5, 1982, Empire Airlines Flight 141, a scheduled commuter flight between Utica, New York, and Washington, D.C., crashed while attempting an approach to Tompkins County Airport, Ithaca, New York, an en route stop. The flightcrew had contacted Elmira approach control and had received instructions for an instrument landing system (ILS) approach to runway 32 at Tompkins County Airport.

About 0740 e.s.t., the copilot declared an emergency stating that the airplane had a landing flap problem; he later stated that only one flap was down. He also stated that they were not able to maintain altitude and that the airplane was descending. Elmira approach lost radar contact with the airplane about 0741 e.s.t.; the last radio transmission from the flight was recorded about 0745.

The airplane crashed in a wooded area near three suburban homes. The pilot and copilot, the only persons aboard, were killed. There were no injuries to personnel on the ground. The aircraft was destroyed by impact and postimpact fire.

The National Transportation Safety Board determines that the probable cause of the accident was excessive wear of the left flap motor/flexible drive spline and certification of the airplane with a flap system that did not meet the requirements of Civil Air Regulation 3.339. The worn spline caused a split flap condition of 34° that resulted in marginal flight control authority. Moderate low altitude turbulence and transient low level wind shear may have contributed to the upset and loss of control.

1. FACTUAL INFORMATION

1.1 History of the Flight

Empire Airlines Flight 141, a Piper PA-31 Navajo (N546BA), was a scheduled commuter flight from Utica, New York, to Washington, D.C., with an en route stop at Ithaca, New York. The Piper PA-31 Navajo was being used for the flight because the airplane normally used was not available. It was scheduled to depart Utica at 0700 1/ and arrive at Ithaca at 0735.

1/ All times herein are eastern standard, based on the 24-hour clock.

The airplane preflight check was performed by a qualified mechanic and signed by an inspector; a portion of the preflight check required an operational check of the flap system. Flightcrew preflight, start, and taxi checks were normal. An Empire Airlines mechanic, standing fireguard, stated that the pilot and copilot occupied their normal cockpit seats. The aircraft departed Oneida County Airport, Utica, New York, at 0709. The en route portion of the flight was normal, and the flightcrew contacted Elmira approach control at 0735 at 6,000 ²/_{feet}. Elmira approach informed the pilots to expect an instrument landing system (ILS) approach to runway 32 at Tompkins County Airport, Ithaca, New York. (See appendix D.) At 0739, the copilot of Empire Flight 141 declared an emergency stating that the airplane had a landing flap problem. He later clarified his statement stating that one flap was down.

During the following 5 minutes, the flightcrew retained control of the airplane while descending gradually from about 2,500 feet to 1,900 feet. At 0744:40, the flightcrew stated that they were on the localizer course at 9 miles from the airport. Fifteen seconds later, in response to a query from the approach controller concerning controllability of the airplane, the flightcrew responded that control was being maintained with difficulty using full right aileron. During this time, the flightcrew continued efforts to land at Tompkins County Airport. They reported at 0740:50 that they were able to see the ground, but never reported that they had the airport in sight, even though the airport lights were on. The last intelligible transmission from the flightcrew was made about 0745:05, although a transmission at 0747:29 was identified as probably having been transmitted by the flightcrew.

The airplane crashed in a wooded area near three suburban homes. Occupants of the homes heard the crash, looked outside, and saw a red and white airplane immediately explode and burst into flames. The airplane was destroyed by impact and postimpact fire; both crewmembers were killed.

The airplane crashed about 0749, during daylight hours. The airplane crashed at latitude 42° 23' 45" N and 76° 23' 52" W at a ground elevation of 1,100 feet.

1.2 Injuries to Persons

<u>Injuries</u>	<u>Crew</u>	<u>Passengers</u>	<u>Others</u>	<u>Total</u>
Fatal	2	0	0	2
Serious	0	0	0	0
Minor/None	0	0	0	0
Total	2	0	0	2

1.3 Damage to the Aircraft

The airplane was destroyed by impact and postcrash fire.

1.4 Other Damage

Several trees were damaged, and there was a ground scar and fuel spill near the airplane.

2/ All altitudes are mean sea level unless otherwise indicated.

1.5 Personnel Information

The flightcrew was certificated and qualified for the flight. (See appendix B.) At the time of the crash, both pilots had been on duty 1 hour 34 minutes, with 40 minutes of flight. The pilot had been on duty 7 hours 30 minutes the day before the accident, with 8 hours 18 minutes of flight time. He had more than 14 hours of off-duty rest time before reporting for work on January 5, 1982. The copilot had been off duty the day before the accident.

1.6 Aircraft Information

The airplane, a Piper PA-31 Navajo, N548BA, (serial No. 31-709) was certificated, equipped, and maintained in accordance with Federal Aviation Administration (FAA) requirements. (See appendix C.) Type certificate for the airplane was issued July 25, 1966, and the airplane was manufactured in 1971. It was issued a Standard Airworthiness Certificate on March 12, 1971, and was purchased by Empire Airlines in 1976. It was equipped with two Avco Lycoming TIO-540-A2B engines.

The gross weight of the airplane was about 5,702 pounds at takeoff and 5,522 pounds when it crashed. Maximum gross takeoff weight was 6,500 pounds. The airplane center of gravity was .055 inch forward of limits at takeoff and within limits when the accident occurred. The airplane had 162 gallons of 100LL fuel on board at takeoff and about 132 gallons when the airplane crashed.

1.7 Meteorological Information

The 0700 surface weather map, prepared by the National Weather Service (NWS), showed north-central New York to be in an area of strong pressure gradient to the southwest of a northeasterly moving low pressure center. Weather conditions over north-central New York were characterized by overcast skies, snow showers, and strong northwesterly winds.

The following was the surface observation for Tompkins County Airport at the approximate time of the accident:

0753: ceiling--estimated 2,500 feet overcast; visibility--5 miles; weather--light snow showers; temperature--27° F; dewpoint--21° F; wind--320° 15 kns, gusting to 30 kns; altimeter--29.78 inches; remarks--aircraft incident.

The winds aloft at Buffalo and Albany at the 0620 and 0600 soundings were:

<u>Altitude (feet above sea level)</u>	<u>Direction (of true)</u>	<u>Speed (kns)</u>
Buffalo		
Surface	300	25
1,725	284	33
2,683	285	37
3,694	293	44
4,621	302	52
5,559	307	54
6,547	309	56

<u>Altitude (feet above sea level)</u>	<u>Direction (of true)</u>	<u>Speed (kns)</u>
Albany		
Surface	260	18
1,206	259	25
2,143	258	30
3,080	264	29
4,031	272	27
5,036	275	27
6,054	277	28

At 0832, the NWS radar at Binghamton, New York, showed Ithaca to be within an area with 6/10 coverage by snow showers. The maximum top of the precipitation was at 7,000 feet. The radar had not been in operation before the 0832 observation.

The following area forecast was issued by the NWS Forecast Office, Boston, Massachusetts at 1940, January 4, 1982, and valid from 2000, January 4 through 1400, January 5 for New England, New York, Pennsylvania, adjacent Lake Erie, Lake Ontario, New Jersey, and adjacent coastal waters:

Flight precautions: For ceiling and visibility below 1,000 feet and 3 miles; eastern New York, New Jersey, New England, and coastal waters becoming occasional north of a Poughkeepsie, Concord, Bangor line, ending south of this line by 0800. Additionally, ceiling and visibility occasionally below 1,000 feet and 3 miles in snow showers; central and western New York, Pennsylvania, and adjacent Lake Erie and Lake Ontario. For low-level wind shear potential principally coastal New York and southeastern New England associated with the cold front.

For occasional severe icing in clouds and in precipitation especially in areas of freezing or mixed precipitation above the freezing level throughout the forecast area improving over southeast Pennsylvania, New Jersey, coastal New York, south New England except the Berkshires, south New Hampshire, south Maine and south coastal waters by 0800 and the remainder of the coastal waters by 1400. Otherwise occasional light to moderate icing in clouds and in precipitation above the freezing level. Freezing level 8,000 to 11,000 feet south coastal waters sloping to at or near the surface extreme north Maine central and west New York, multiple freezing layers surface to 6,000 feet northern New England. Freezing level lowering to at or near the surface through most of the forecast area except 1,500 to 3,000 feet coastal sections and coastal waters after 0800.

For moderate turbulence below 12,000 feet, occasionally severe below 8,000 feet throughout the forecast area through 1400. Occasional light to moderate clear air turbulence 20,000 to 35,000 feet throughout the forecast area.

The following SIGMET's, 3/ issued by the NWS Forecast Office, Boston, were considered pertinent to the flight:

3/ Significant meteorological information.

SIGMET Delta 11, Valid: 0300 to 0700, January 5, 1982.--Maine, New Hampshire, Vermont, New York, Pennsylvania, and adjacent Lake Erie and Lake Ontario. From 30 miles northwest of Caribou to 90 miles north-northeast of Bangor to 40 miles southwest of Harrisburg to 50 miles northeast of Parkersburg to 40 miles north-northwest of Erie. Locally severe mixed icing in clouds and in precipitation above the freezing level. Freezing level at or near the surface over western New York, western Pennsylvania, sloping to 6,000 to 8,000 feet over northern Maine. Continue advisory beyond 0700. SIGMET Delta 12, valid from 0700 to 1100 extended the warning of the icing hazard.

SIGMET Echo 6. Valid: 0500 to 0900, January 5, 1982.--Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania, adjacent Lake Erie and Lake Ontario, New Jersey, and adjacent coastal waters. From 30 miles north of Caribou to 160 miles east-southeast of Atlantic City to 50 miles northeast of Parkersburg to 40 miles north-northwest of Erie. Occasional severe turbulence below 8,000 feet especially within 4,000 feet above ground level across rough terrain with up and down drafts. Additionally, low level wind shear potential due to strong lowlevel wind over the same area. Continue advisory beyond 0900.

The pilot of N546BA received a weather briefing from the Empire Airlines dispatcher before departing Utica, New York.

1.8 Aids to Navigation

There were no reported navigational aids difficulties.

1.9 Communications

There were no reported communications difficulties.

1.10 Aerodrome Information

The Tompkins County Airport was fully operational at the time of the accident.

1.11 Flight Recorders

The airplane was not equipped with either a cockpit voice recorder or a flight data recorder, and neither was required.

1.12 Wreckage and Impact Information

The accident site was in a wooded hillside area, elevation about 1,000 feet, between three residences. It was 6.7 statute miles/168° from the Tompkins County Airport. The wreckage distribution pattern, oriented on a heading of 140°, was about 212 feet long and 32 feet wide. (See appendix B.)

The airplane first hit the trees about 60 feet above ground level. The airplane first hit the ground about 120 feet horizontally from initial tree impact. The pattern of damage to the trees indicated that the airplane passed through the trees with an 80° to 90° left wing-down bank angle and a 24° nosedown pitch angle.

The disintegration of the airplane was extensive. Parts of all major sections of the structure and of the flight control surfaces were identified at the wreckage site. The intense ground fire consumed about 85 percent of the fuselage, wings, and empennage; the landing gear was found retracted.

The left wing flap jackscrew assembly remained intact and attached to wing and flap structure. The jackscrew was found in the retracted position. The cable assembly was intact and attached to the jackscrew transmission unit. The inboard female spline component of the left flap flexible cable was found separated from the cable and from the male splines of the flap motor. The internal splines of the female component were worn, and the male spline rotated within the female spline when the two were mated and turned by hand.

The right wing flap jackscrew was found separated from wing and flap structure. The jackscrew was extended and 24 of 28 threads were exposed. Full flap extension was 40°, so that the position of the jackscrew indicated that the right wing flap was extended about 34° down. Both jackscrews could be turned by hand.

Both engines and propellers were found in the wreckage. The engines were damaged by impact and postimpact fire. The propellers showed evidence of rotational damage.

1.13 Medical and Pathological Information

Postmortem examination of both flight crewmembers was performed by the Tompkins County Medical Examiner at the Tompkins Community Hospital, Ithaca, New York. Both flight crewmembers sustained extensive multiple traumatic injuries due to impact. Both victims received extensive third degree burns to the body with partial incineration.

During the autopsies, blood, urine, and tissue samples were taken from each crewmember for toxicology and hematology. Portions of these samples were sent to the FAA's Civil Aeromedical Institute (CAMI) laboratory in Oklahoma City, Oklahoma, and the New York State Police Laboratory, Ithaca, New York, for analysis. Results of both analyses were negative for drugs and alcohol. CAMI results indicated that the copilot's blood had less than 1 percent carbon monoxide.

1.14 Fire

There was no evidence of in-flight fire. At 0741, shortly after Flight 141 reported its emergency flap condition, Tompkins County Airport crash/fire/rescue (CFR) vehicles were placed on standby on the airport taxiway. They were recalled after the accident and did not leave the airport. The Brooktondale fire and rescue unit was notified at 0751 and was en route by 0752. It arrived on scene by 0756, at which time the airplane was fully engulfed in flames. Firefighters applied 1,000 gallons of water to the fire, extinguishing it in less than 10 minutes.

1.15 Survival Aspects

Impact forces were beyond human tolerance; therefore, the accident was not survivable.

1.16 Tests and Research

1.16.1 Split-Flap Flight Tests

On February 1, 1982, the chief of the FAA's Southern Region Aircraft Certification Office wrote to Piper Aircraft Company concerning the accident. The letter stated in part:

Civil Air Regulation (CAR) 3.339 3/, states that a mechanical interconnection is required unless the airplane is demonstrated to have safe flight characteristics while the flaps are retracted on one side and extended on the other.

It has, therefore, been determined that Piper must demonstrate safe-flight characteristics with full flap asymmetry or provide limits of flap asymmetry that can be handled by a pilot without requiring exceptional degree of skill, alertness or strength and without exceeding the limit load factor under all types of operation probable for the type. If limits less than full flap asymmetry are established, we will consider these as maximum flap extension limits for all operations until a permanent fix can be defined and installed.

3/ Flap interconnection. The motion of flaps on opposite sides of the plane of symmetry shall be synchronized by a mechanical interconnection, unless the airplane is demonstrated to have safe flight characteristics while the flaps are retracted on one side and extended on the other.

As a result, Piper Aircraft Company modified a Piper PA-31 aircraft with individually operated flaps and performed a number of test flights. The project (No. 31-012-51) test report, dated April 16, 1982, states:

... flight tests were conducted to determine the critical flap (left or right flap more critical), the degree of tolerable asymmetry and the effects of airspeed on controllability with an asymmetric flap condition. These tests were conducted with symmetrical power for level flight, zero bank angle and sufficient rudder for zero yaw. The results of this testing including airspeed, gear position, flap deflection angles, aileron deflection (Sa), and aileron force (Fa) are:

<u>Run</u>	<u>Altitude</u> (ft)	<u>KIAS</u>	<u>Pwr</u>	<u>Gear</u>	<u>FLAPS</u>		<u>Sa</u> ^{1*} (percent)	<u>Fa</u> (lbs)	<u>Remarks</u>
					<u>Lt</u>	<u>Rt</u>			
1	10,000	130	Lvl Flt	Ret	0°	15°	50	12	
1a		145					60	13	
1b		160					70	15	
1c		115					50	5	
1d		100					50	9	
1e		85					45	11	
2	10,000	130	Lvl Flt	Ret	15°	0°	55	18	
2a		160					70	25	
2b		100					50	11	

Run	Altitude (ft)	KIAS	Pwr	Gear	FLAPS		Sa 1* (percent)	Pa (lb)	Remarks
					Lt	Rt			
2c		85					65	10	
3	9,000	130	Lvl Flt	Ret	0°	25°	85	17	
3a		145					85	20	
3b		160					90	23	
3c		115					80	12	
6	9,500	130	Lvl Flt	Ret	25°	0°	90	24	
6a		160					95	30	
6b		100					85	18	
6c		85					85	14	
7	9,000	130	Lvl Flt	Ret	30°	0°	100	-	Aircraft Diverges in Rt. Roll at approx. 2-3°/sec

* Aileron deflection is approximate. Deflections were estimated as a percentage of total wheel deflection.

As the data indicate, the left-flap-extended asymmetric condition is the more critical of the two; the maximum tolerable asymmetric flap angle is between 25° and 30° and control margins, as measured by the remaining aileron control travel, do not vary appreciably with airspeed; however, aileron control forces vary proportionately.

With the critical asymmetric flap condition tentatively defined, additional testing was conducted in this configuration to determine the effects of symmetrical power on airplane control. Also, a single flap retraction from a symmetrical flaps-extended configuration condition was evaluated.

With the left and right flap set to 25° and 0°, respectively, the aircraft was trimmed to 110 knots indicated airspeed (KIAS) using symmetrical power to achieve an approximate 3° flight-path descent angle. Using power, the airspeed was gradually reduced to 85 KIAS and then increased to 153 KIAS. Adequate lateral control margins existed and aileron deflection and forces were similar to those identified during the level flight tests.

A similar evaluation was conducted using maximum continuous power with the airplane initially trimmed to 100 KIAS. Over a speed range of 85 KIAS to 153 KIAS, lateral control margins were considered adequate and, again, aileron deflection and forces did not vary appreciably from either the corresponding power used for the level flight tests or the approach power used for the approach configuration tests.

The effects on airplane lateral control were also evaluated during an asymmetric flap retraction. This evaluation was conducted by positioning both flaps to the 25° position and then rapidly retracting the right flap. This test was accomplished in both the balked landing climb and approach power configurations. After retracting the flap, the aircraft was allowed to deviate about 30° in roll, before the recovery was begun. During the recovery, sufficient lateral control was available to arrest the roll and to return the airplane to a wings-level attitude.

As a result of these tests and the Empire Airlines Flight 141 accident, Piper Aircraft Company issued Service Bulletins Nos. 739 and 741 concerning restriction of flap travel and inspection of the wing flap flexible drive shaft. (See appendix F.)

1.17 Additional Information

1.17.1 PA-31 (Navajo) Flap System

The flap system on the PA-31-310 (Navajo) is electrically actuated and driven. (See figure 1.) The flaps are controlled by a switch, which is shaped like an airfoil and located on the instrument panel to the right of the center control pedestal. The switch

activates an electric motor which is mounted under the center cabin floor nearly in line with the flaps. The drive motor is reversible and has male drive splines at each end connected by female spline fittings to flexible drive shafts. The flexible drive shafts extend into each wing where they connect to the left and right flap jackscrew transmissions which turn to move the respective flap up or down.

Microswitches located in the left wing limit flap up and down travel. A rheostat, also located in the left wing, actuates the flap position indicator located above the flap selector switch in the cockpit. A time-delay relay located near the flap motor stops the motor if an asymmetric flap condition occurs when the flaps are selected to the down position. If the flaps do not extend together (the left flap does not leave the up limit switch), the time delay relay will turn the flap motor off within 1 second (about 9° of flap travel), and the flap selector will become inoperative until the time-delay relay is reset. The time-delay relay can be reset by pulling the flap control circuit breaker, located in the cockpit, and resetting it. The time-delay relay does not affect flap motor operation if the left flap is not at the up or down limit.

The Piper Navajo Information Manual, which is not an FAA-approved document, is for general information purposes and states:

CAUTION-DO NOT reset the flap time delay relay system while the aircraft is in flight. Resetting the system will allow an additional one second of flap travel and can cause the flap asymmetry to become more severe. Reset the flap system only after the aircraft has landed.

Since the limit switches are on the left flap only, a failure of the right flap system can be compensated for by the use of the flap selector to position the left flap symmetrically with the right.

The time-delay relay does not affect the system if a failure occurs at any point after the left flap has left either the up or down limit switch. If a failure occurs in either flap system (when the left flap

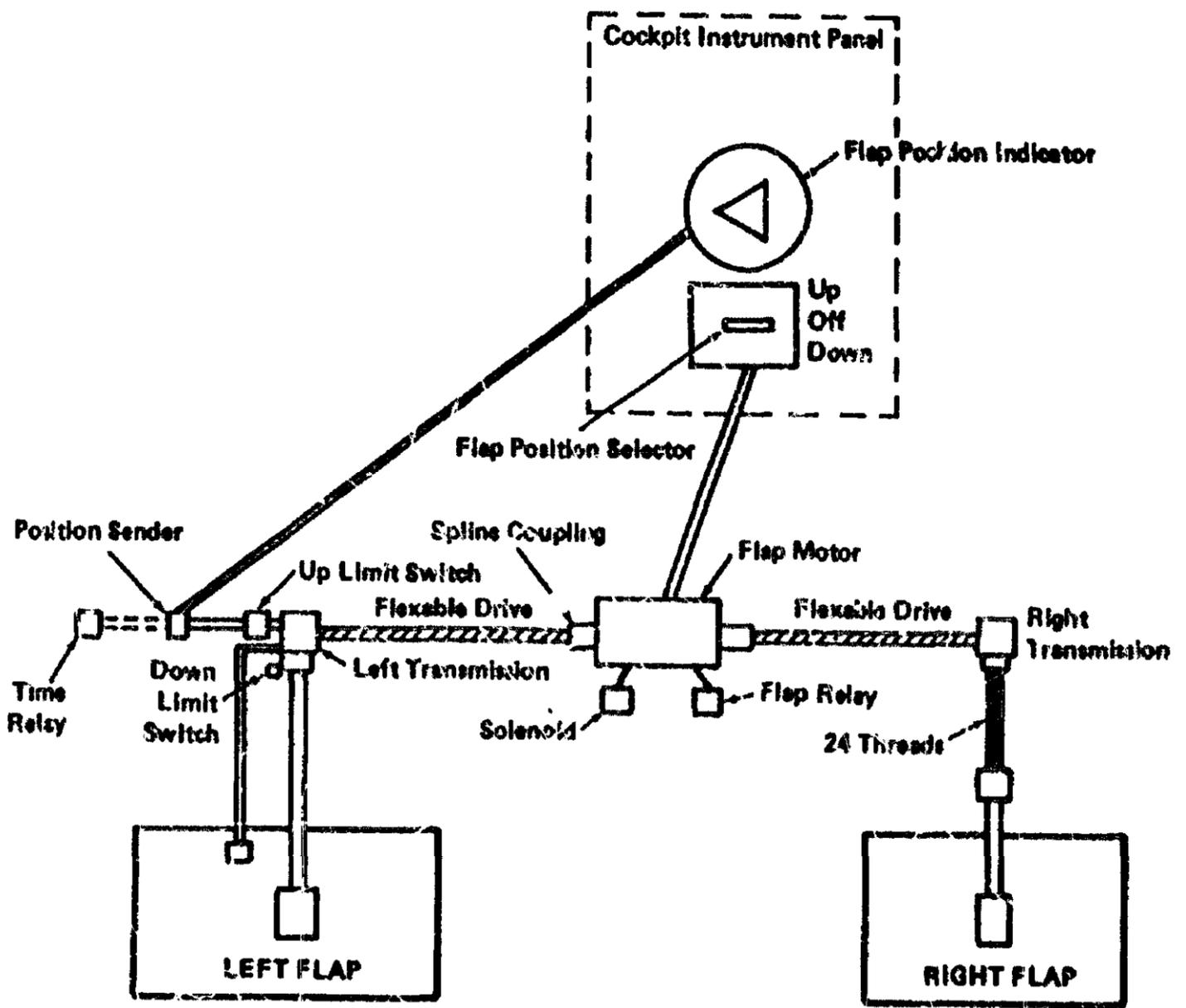


Figure 1.--PA-31-310 (Navajo) flap system.

is not in contact with a limit switch) use the flap selector switch to bring the operable flap to a symmetrical configuration with the inoperable flap.

An electrical brake in the flap motor prevents the flaps from coasting when intermediate flap settings are selected.

1.17.2 Airplane Flap System Maintenance History

The Safety Board reviewed relevant Airworthiness Directives (AD's) and found that they had been recorded and accomplished. Airworthiness Directive 81-11-03, Inspection of Wing Flap Transmission, had last been complied with on December 29, 1981, with the airplane total time at 5,891.7 hours. This inspection was in accordance with Piper Service Bulletin 494B which contains information to inspect the flap transmission if necessary. The inspection is required every 100 operational hours. The flexible shafts are not disconnected during this inspection.

Airplane maintenance records indicated that on April 17, 1979, when airplane total time was 3,793.8 hours, the following wing flap system components were replaced: (a) flap drive motor because it was inoperative; (b) flap transmissions, left and right because they were worn; (c) flap position transmitter because it was inoperative; and (d) time-delay relay, because it was inoperative.

The records did not reveal any information to indicate that the flexible drive shafts had ever been replaced. However, the drive splines on the motor and on the flexible drives must be inspected when the flap drive motor is replaced and the flexible shafts are disconnected.

During its review of the nonroutine work cards, the Safety Board noted that on December 17, 1981, the wing flaps were written up as being inoperative. As a result, corrosion was removed from the up limit switch and flap operation was checked. Piper Service Letter 764A, dated July 17, 1979, recommends that if flap operational problems occur the flexible drive shaft splined couplings should be inspected for wear and security. The last postflight inspection had been accomplished on January 5, 1982; flap operation was checked during this inspection. The flaps reportedly operated satisfactorily.

1.17.3 Flightcrew Operating and Emergency Procedures

The Piper Navajo Information Manual states:

To preclude the possibility of encountering large asymmetric ("split") flap angles due to a failure in the flap actuating system, the following procedures should be followed for flap extensions and retractions:

1. Actuate the flaps only while the airplane is under manual control. DO NOT make flap selection while the autopilot is engaged. The autopilot will mask the high control forces created by an asymmetric flap condition.
2. Extend the flaps in a minimum of two steps (0° to 15°, then 15° to 40° or final setting) or preferably in four steps of approximately one second activation each. DO NOT initiate the successive extension step until a symmetric position is verified by a negligible change in aileron/rudder cockpit control positions to hold straight flight.

3. Retract the flaps in a minimum of two steps (40° or extended setting; to 15° then 15° to 0°) or preferably in four steps of approximately one second activation each. Verify symmetric position to the first steps as in (2) above, before proceeding to complete retraction.
4. Do not extend the flaps beyond 15° if the flap motor circuit breaker has a history of popping. A popped circuit breaker is indicative of excessive actuation loads on one or both flaps; such loads are most likely at flap angles in excess of 15°. The airplane should not be flown until the cause of the high loads is determined and repairs effected.

The FAA-approved Airplane Flight Manual, revised February 20, 1981, which forms a pattern of the Piper Navajo Information Manual, states:

ASYMMETRIC FLAP EXTENSION (Emergency Procedure 3-16)

- a. Split Flaps (0° and 15° or 15° and 40°)
 - (1) Flap switch - off
 - (2) Airspeed - 110 MPH
 - (3) Aileron - maintain wings level
 - (4) Flap switch - opposite direction (try to obtain symmetric flaps)
 - (5) Land as soon as possible at nearest suitable airport
- b. Split Flaps (0° and 30°, 0° and 40°)
 - (1) Flap switch - off
 - (2) Airspeed - 110 MPH
 - (3) Aileron - maintain wings level
 - (4) Rudder - in direction of flap with largest deflection
 - (5) Asymmetric power - into the flap with largest deflection (add power on side with the smallest flap deflection)
 - (6) Flap switch - opposite direction (try to obtain symmetric flaps)
 - (7) Land as soon as possible at nearest suitable airport

1.17.A Flightcrew Training

The Empire Airlines written training program for the Piper Navajo did not specifically cover asymmetric flap extension emergencies. However, the normal operating precautions used to prevent split flaps were covered in pilot ground school and during pilot proficiency flight checks. Empire Airlines supervisory and operations personnel stated that the pilot and copilot normally extended and retracted the flaps in incremental steps of 10° to 15°.

2. ANALYSIS

2.1 General

The airplane was maintained in accordance with approved procedures. There was no evidence of pre-incident failure or malfunction of the airplane powerplants or structures. The flightcrew was properly certificated and qualified for this scheduled domestic passenger flight.

An analysis of the weather data indicated that throughout the time period and along the route of Flight 141, moderate turbulence would have been prevalent with occasional severe turbulence likely from the surface to above 6,000 feet. As the airplane descended to lower altitudes, it undoubtedly encountered moderate to severe mechanical turbulence because of the high winds aloft, the high and gusty surface winds, and the hilly terrain. There would have been low level wind shear with slower northwest winds near the surface because of surface friction. This wind shear would have been transient because of turbulent mixing. There would have been light rime icing in the clouds. Cloud bases at Ithaca were about 2,500 feet above the surface, about 3,600 feet above sea level, and cloud tops varied between 6,000 and 9,000 feet. The weather forecasts were substantially correct and the hazardous weather warnings were adequate.

2.2 Flap System Malfunction

The wing flaps reportedly worked satisfactorily during the January 5, 1982, maintenance postflight inspection. Inspection of the wing flap transmissions was completed in accordance with Airworthiness Directive 81-11-03 on December 29, 1981 -- 7 days before the accident. The splines of the flexible drive shafts are not routinely disconnected for this inspection. The wing flaps did not operate during a flight on December 17, 1981. The discrepancy was corrected by removing corrosion from the up limit switch. There was no evidence that the drive splines were examined for wear and security as recommended by Piper Service Letter 764A. On April 17, 1979, the flap drive motor, both flap transmissions, the flap position transmitter, and the time-delay relay were replaced. The drive splines should have been inspected at this time. Since there was no information in the maintenance records to indicate that the flexible shafts had been replaced since the airplane was put in service, the Safety Board concludes that the flexible drive shafts had not been replaced, and that the drive splines on the flexible shafts were last inspected on April 17, 1979.

The components of the flap system were too badly damaged by impact and postimpact fire for meaningful testing. However, the maintenance preflight includes a check of the flap system, requiring a full extension and retraction, and the flightcrew before-takeoff check also requires a flap check. The Safety Board believes that the flightcrew probably complied with the checklist and that the flap system was probably operable when the airplane departed Utica. Since damage to the flap system electrical components precluded any testing, a malfunction of those components could not be verified. However, the flap motor, both flexible drives, and both jackscrew transmissions were examined. The female spline of the left flap flexible drive was worn; it rotated when fitted to the flap motor male spline and turned by hand, indicating that the motor could not effectively transmit torque from the motor to the left flap flexible drive.

Examination of the wreckage confirmed that the left wing flap was on the up position and the right wing flap was extended to about 34°. The flap system design is such that when the selection for flap extension is initiated a time relay is activated. Should the left flap fail to extend from the full up position, the flap motor will deactivate after 1 second during which the right flap will extend about 2°. Therefore, the Safety Board must conclude that when the crew selected flap extension, both flaps began to extend. However, as the air loads began to oppose flap travel, the worn left spline coupling, which normally transmitted torque from the flap motor to the left flap transmission, began to slip thus slowing or stopping the extension of the left flap at an intermediate position. The right flap continued to extend at its normal rate.

The normal flap extension procedures specify that the crew activate the flap switch in two steps--0 to 15°, then 15° to 40° or to final flap setting. Normally, the 15° travel would occur in about 2 seconds. However, if the pilot making the flap selection were observing the flap position indicator, it would have shown a slower than normal extension since the indicator is driven by the left flap. Thus, the right flap would probably have traveled through its full 40° range before the indicator showed the target setting. In any event, the Safety Board believes that the copilot selected the flap extension and was observing the flap indicator while the pilot was controlling the airplane. The pilot undoubtedly sensed the lateral control required to maintain wings level flight as the flap asymmetry developed. However, the forces would not have been excessive until nearly full travel occurred. The Safety Board believes at this point, the pilot ordered the flaps retracted in accordance with the asymmetric flap emergency procedures. Upon this selection, both flaps probably began to retract normally, the left spline coupling was able to transmit partial torque to the left flexible drive because of the assisting rather than opposing air loads. The left flap retracted and made contact with the up-limit switch shutting off the flap drive motor with the right flap only retracted to 34°. Once the up-limit switch was engaged, the flap drive motor could not be activated by movement of the flap switch to the "up" position. Therefore, the flightcrew could not retract the right flap to correct the split flap situation.

The postaccident flight tests conducted by the airplane manufacturer established that an asymmetrical flap condition of 30° was not controllable at 9,000 feet and an airspeed of 130 KIAS. However, the tests did not include the use of asymmetric power or the use of rudder to control the airplane laterally. Therefore, the Safety Board believes that the flightcrew of the accident airplane was able to maintain lateral control with an asymmetric flap condition of about 34° because they used rudder and asymmetric power as specified in the emergency procedure, that is, full or near full power on the left engine and reduced power on the right engine. Consequently, although they were able to maintain lateral control, there was not sufficient power to either maintain altitude or to provide directional control.

The evidence establishes clearly that the flightcrew encountered a flight control problem. Also, based on the airplane's impact angle, altitude, and direction, the Safety Board believes that control was lost suddenly. Based on the location of the wreckage and the flightcrew's last position report, the Board determines that the crash occurred about 0749.

In summary, the Safety Board believes that the most probable accident sequence was as follows. The flightcrew made a flap-down selection before intercepting the ILS final approach. The worn female fitting of the left flap motor flexible drive spline prohibited the left flap from fully extending during this flight. Thereafter, symmetry of the flaps could not be attained because of the system design and the flightcrew declared an emergency and asked for vectors to the Tompkins County Airport. The flightcrew was not able to maintain altitude and had to use full aileron control, asymmetrical power, and rudder to maintain wings level flight. Airplane control was tenuous, and moderate to severe turbulence, along with transient low level wind shear, added to airplane handling difficulties. Although the Safety Board could not determine what initiated the final control loss, about 0749 control was lost and the airplane could not be recovered by the flightcrew because of the split flap condition.

While the Empire's flight training program did not specifically address asymmetric flap extension, the topic was covered during the ground phase of initial and recurrent training. The FAA-approved airplane flight manual has a split flaps condition emergency procedure. Consequently, the Safety Board believes that while the flightcrew

was not specifically trained in reacting to a split flap condition, they were aware of the correct procedures to be followed. Empire Airlines procedures called for incremental extension and retraction of the flaps, and the Safety Board has no evidence to indicate that the flightcrew deviated from these procedures.

2.3 Aircraft Certification

The flight tests conducted by the airplane manufacturer in response to the FAA's inquiry of February 1, 1982, about compliance with CAR 3.339 clearly demonstrated that the flap system in certain models of the PA-31 airplane, including the accident airplane, did not meet the requirements of the regulation. The tests established that with less than full extension on one flap (30°) and the other flap in the retracted position, the airplane was not controllable laterally. According to the regulation, under these conditions, the flaps should have had a mechanical interconnection to synchronize movement of the flaps. However, the flap system did not include such a mechanical interconnection. Consequently, PA-31 airplanes equipped with this flap system were not properly certificated. After the manufacturer's flight tests of the flap system, appropriate measures were taken by the manufacturer and the FAA to remedy the improper certification.

Typical of general aviation airplanes, the PA-31 was certificated under the provisions of the FAA's delegated option authorization (DOA) which permits the airplane manufacturer to conduct the necessary engineering evaluations and flight tests to demonstrate compliance with the applicable regulatory requirements. During certification of the PA-31, FAA personnel reviewed the manufacturer's certification data, but the data apparently failed to show compliance with CAR 3.339, and the failure was not detected during the FAA's review process.

The Safety Board acknowledges the need for the DOA which is analogous and related to the designated engineering representative (DER) program associated with the certification of new airplanes and new airplane components. The need for the DER program was reviewed by the National Research Council 4/ which concluded that the DER is not only appropriate but indispensable. Further, the Safety Board has not found any other deficiencies in the DOA process since its investigation of a Beechcraft B-99 accident on July 6, 1969, 5/ which elicited several Safety Board recommendations concerning the processes that were implemented by the FAA. Consequently, since the PA-31 was certificated in 1966, we believe that the improper certification of the flap system on the PA-31 was an isolated oversight in the DOA process that has since been corrected.

3. CONCLUSIONS

3.1 Findings

1. The airplane was maintained in accordance with approved procedures.
2. There was no evidence of preimpact failure or malfunction of the airplane powerplants or structures.

4/ Improving Aircraft Safety, National Academy of Sciences, Washington, D.C., 1980.

5/ Aircraft Accident Report: Air South Inc., Beechcraft B-99, N844NS, near Monroe, Georgia, July 6, 1969 (NTSB-AAR-70-18).

3. The flightcrew was properly certificated and medically qualified for the flight.
4. The accident was not survivable.
5. The FAA-approved airplane flight manual contained an emergency procedure concerning asymmetric flaps.
6. The flightcrew had no formal training in split flap conditions; however, they were aware of the correct procedures.
7. The flexible drive shafts on the airplane had never been replaced, the drive splines on the flexible shafts were last inspected on April 17, 1979.
8. The flap system was operating when Flight 141 departed Utica.
9. The worn female fitting on the left flexible drive slipped and prevented the flap motor from driving the left flap at the same rate as the right flap.
10. The asymmetric flap condition could not be corrected by raising the flaps since the flap motor would be deactivated as soon as the left flap contacted the up-limit switch.
11. Moderate turbulence and low level wind shear were present in the Ithaca area at the time of the accident.
12. The split flap configuration of the airplane resulted in a loss of control and prevented recovery of the airplane.
13. The PA-31 with this flap system did not meet the requirements of CAR 3.339 and, therefore, had not been properly certified in 1966.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was excessive wear of the left flap motor/flexible drive spline and certification of the airplane with a flap system that did not meet the requirements of Civil Air Regulation 3.339. The worn spline caused a split flap condition of 34° that resulted in marginal flight control authority. Moderate low altitude turbulence and transient low level wind shear may have contributed to the upset and loss of control.

4. CORRECTIVE ACTIONS

As a result of this accident and subsequent flight testing, Piper Aircraft Corporation issued Service Bulletins 739 and 741 on March 1, 1982. (See appendix F.) Bulletin 739 applies to Piper PA-31 Navajo and Chieftain airplanes and Bulletin 741 applies to Cheyenne airplane. Bulletin 739 is in three parts:

Part 1 restricts the use of full flaps to 25°, requires installation of temporary placards and incorporation of hand written Pilot's Operating Handbook/Aircraft Flight Manual revision until compliance with Part III of the Service Bulletin is completed. Compliance time is within 25 hours of operation.

Part 2 includes detailed instructions for inspection of the wing flap flexible shaft assemblies and compliance time is within 100 hours of operation and at 500 hour intervals thereafter.

Part 3 describes the appropriate Piper Modification kits which provide instructions, placards, and hardware for positive restriction of flap travel, and incorporates information regarding permanent Pilot's Operating Handbook/Aircraft Flight Manual revisions. Compliance time is on or before August 1, 1982.

Bulletin 741 is similar except that flap operation is restricted to 15° since the average aircraft has only a two-position flap switch, 15° and 40°.

The FAA issued Airworthiness Directive 82-08-06 on April 23, 1982, which made the provisions of the Service Bulletins mandatory with the same compliance times. (See appendix G.)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ PATRICIA A. GOLDMAN
Vice Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ G. H. PATRICK BURSLEY
Member

/s/ DONALD D. ENGEN
Member

JIM BURNETT, Chairman, did not participate.

DONALD D. ENGEN, Member, filed the following statement.

I wish to state that I was employed by the Piper Aircraft Corporation for approximately two years as General Manager, Lakeland Division, and Director of Government Operations. During that time, I was not directly involved with the certification process for the PA-31 Flap System, this having occurred much earlier. I have participated in the deliberation of this report with a view that my experience as a plant manager for a general aviation manufacturer would allow a degree of understanding of this matter by the Board that might not be possible if I were to abstain from participation. I concur in the Analysis, Conclusions, Probable Cause, and Recommendations, with the following exception:

In my view, certification for design and manufacture of component systems in airplanes is valid at the time the system is determined to meet the requirements of the applicable Civil Air Regulation (CAR) after appropriate review and testing procedures. Subsequent failure of components in those systems does not necessarily mean that the original certification was not valid. In the case of the PA-31 Flap System, I

believe the airplane was properly certified in that after appropriate review and testing procedures, the FAA had no reason to believe that the flap system did not meet the requirements of CAR 3.339. Subsequently, and I stress subsequently, the system developed failure modes, and has been modified over the years in light of knowledge gained after original certification in order to continue to meet the requirements of CAR 3.339. I am uncomfortable with the majority statement that one of the probable causes of this accident was "Certification of the airplane with a flap system that did not meet the requirements of CAR 3.339," since this statement implies that the original certification was done improperly, I would prefer to say "The post-certification development of flap system failure modes resulting in the failure of the flap system to continue to meet the requirements of CAR 3.339 also contributed to the accident."

September 22, 1982

8. APPENDICES
APPENDIX A
INVESTIGATION AND HEARING

1. Investigation

The Safety Board was notified of the accident about 0900 on January 5, 1982. A partial team was immediately dispatched from the Washington, D.C., headquarters and arrived on scene about 1300. Working groups were established for structures, systems, maintenance records, human factors, air traffic control/witnesses, weather and aircraft performance.

Parties to the investigation were the Federal Aviation Administration, Piper Aircraft Corporation, Avco-Lycorning Company, Empire Airlines, and the New York State Police.

2. Public Hearing

A public hearing was not held. Depositions were not taken.

**APPENDIX B
PERSONNEL INFORMATION**

Pilot-in-Command James C. Donley

Pilot Donley, 26, was employed by Empire Airlines on July 29, 1979, and was current as pilot in command of Piper PA-31 and Swearingen SW-4 Metro aircraft. He held Air Transport Pilot Certificate No. 105 48 8007 for multiengine land aircraft and commercial privileges for single engine land aircraft. His latest proficiency check for the Piper PA-31 was on July 31, 1981, and for the Swearingen Metro was on September 12, 1981.

Pilot Donley had about 3,300 total flying hours with about 728 hours in the PA-31. He had flown 265 hours in the past 90 days, 39 hours in the PA-31 with 247 landings. He held a valid first class medical certificate, with no waivers or limitations, dated September 2, 1981.

Second in-Command Bryland W. Kroeger

Copilot Kroeger, 23, was employed by Empire Airlines on August 8, 1981, and was current as second in command on Piper PA-31 and Swearingen SW-4 Metro aircraft. He held Air Transport Pilot Certificate No. 088 58 9168 for multiengine land aircraft and commercial privileges for single engine land aircraft. His latest proficiency check for the Piper PA-31 was in September 1981.

Copilot Kroeger had about 2200 total flying hours with about 380 hours in the PA-31. He had flown 236 hours in the last 90 days, 26 hours in the PA-31, with 130 landings. He held a valid first class medical certificate with no waivers or limitations, dated October 5, 1981.

**APPENDIX C
AIRCRAFT INFORMATION**

Piper PA-31 Navajo, N548BA, serial No. 31-709 had about 5,906.5 flying hours at the time of the accident.

Empire Airlines approved aircraft inspection program consisted of eight inspection events separated by a time interval of 50 + 10 hours. The aircraft had received a number 8 inspection on January 3, 1982 with the aircraft total time at 5,900.3 hours.

The records reviewed reflected a documentation of maintenance and modifications on the aircraft, engines, and components. The maintenance checks and inspection were shown to have been completed within their specified time limits. The records also indicated that the aircraft was being maintained in accordance with FAA rules and regulations.

The aircraft was equipped with two Avco Lycoming engines Model TIO-540-A2B and Hartzell Propellers Model HCB-3YR-2ATP.

<u>Engines</u>	<u>Left</u>	<u>Right</u>
Serial Number	L-1125-61	L-1241-61
Date Installed	June 2, 1981	June 2, 1981
Time Since Major Overhaul	1,006.74 hours	937.74 hours
Time Since Installation	411.74 hours	411.74 hours
Time Since Last Inspection	52.0 hours	52.0 hours

<u>Propellers</u>	<u>Left</u>	<u>Right</u>
Serial Number	DJ3632	DJ3907
Date Installed	June 2, 1981	June 2, 1981
Time Since Major Overhaul	411.74 hours	411.74 hours
Time Since Installation	411.74 hours	411.74 hours
Time Since Last Inspection	5.5 hours	5.5 hours

APPENDIX D
PARTIAL AIR TRAFFIC CONTROL TRANSCRIPT

This is a partial transcription of recorded transmissions from the Chemung County Airport, Elmira, N.Y., Air Traffic Control Tower from 0734 to 0749, January 5, 1982.

<u>Agencies Making Transmissions</u>	<u>Transmission</u>
Syracuse Approach Control	SYR APP
Elmira/Ithaca Arrival/Departure Radar	ELM AR/DR
Elmira/Ithaca Flight Data	ELM FD
Ithaca Tower	ITH TWR
Empire 141BMP 141	
0734:30 SYR APP	Elmira Syracuse sixteen line handoff
0734:35 ELM AR/DR	Elmira
0734:40 SYR APP	Three southwest of Cortland Empire one forty-one - - - is at six thousand your control
ELM AR/DR	Empire one forty-one radar contact
SYR APP	(alright)*
0734:45 ELM FD	Ithaca, here's an inbound for ya
ITH TWR	Go ahead
ELM FD	Okay its' Empire one forty-one show him as Navajo this morning - -coming over Cortland right now and - - - we're gonna go for the ILS on him I guess. Okay.
ITH TWR	Okay thanks S-K
0735:00 BMP 141	Ah good morning Elmira, Empire one forty-one, level six thousand

Agencies Making Transmissions

Transmission

	ELM AR/DR	Empire one forty-one Elmira approach Ithaca altimeter is two niner seven six expect ILS approach runway three two wind is two two zero - - at one seven gusts to two six
0735:20	EMP 141	One forty-one, roger
0735:25	ELM AR/DR	Empire one forty-one, say your heading
	EMP 141	Two sixty for one forty-one
0735:30	ELM AR/DR	Roger turn left, heading two one zero vectors to the ILS final approach course descend and maintain three thousand two hundred
0735:40	EMP 141	Left two one zero down to thirty two hundred Empire one forty-one
0737:15	ELM AR/DR	Empire one forty-one turn right heading two three zero
0737:20	EMP 141	Right two three zero Empire one forty-one
0739:40	ELM AR/DR	Empire one forty-one turn right heading two eight zero
0739:45	EMP 141	(one forty-one)* Declaring emergency want vectors direct to the airport one flap--
0739:50	ELM AR/DR	Empire one forty-one roger turn further right heading three zero zero
0739:55	EMP 141	Right to three zero zero one forty-one
0740:00	ELM AR/DR	Empire one forty-one say the nature of emergency sir
	EMP 141	One flap down one flap--

Agencies Making Transmissions

Transmission

0740:10	ELM DR/DR	Okay do you want to make the ILS or you want vectors for the visual approach?
0740:15	EMP 141	Visual straight to the airport.
0740:20	ELM AR/DR	Okay I've lost radar contact what's your altitude.
	EMP 141	We're at twenty-five hundred
0740:25	ELM AR/DR	Okay can you maintain any higher altitude or do you have ground contact at twenty-five hundred?
0740:30	EMP 141	Yeh, we have (unintelligible) good enough altitude for the airport twenty-five hundred can't climb
0740:45	ELM AR/DR	One forty-one I didn't get the last part I've lost radar contact with you heading of approximately three hundred should be pretty good for the airport understand you have ground contact is that correct?
0740:50	EMP 141	That's correct we have ground contact and at twenty-four hundred
0740:54	ELM AR/DR	Okay I won't be able to get you at that altitude you should be picking up the localizer I suggest you fly inbound on the localizer and you'll be lined up for runway thirty two your position is approximately seven or eight miles southeast of Ithaca airport.
0741:05	EMP 141	One forty-one roger
0741:25	ELM AR/DR	Empire one forty-one do you wish to remain this frequency or do you want to work Ithaca tower report to me if you have the Ithaca airport in sight.

Agencies Making Transmissions

Transmission

0741:35	EMP 141	We'll call you when we get the airport in sight.
	ELM AR/DR	Roger
0741:40	ELM AR/DR	Hey Ithaca I'll just keep him on me till he gets the airport Okay.
	ITH TWR	Roger
0741:50	ELM AR/DR	And one forty-one are you tracking inbound on the localizer?
	EMP 141	Have not intercepted it yet, one forty-one
0741:55	ELM AR/DR	Okay which way do you show you show it still to your left or to right?
	EMP 141	To our left
0742:00	ELM AR/DR	Okay sir and your heading is about three hundred?
	EMP 141	(That's correct)
	ELM AR/DR	(Okay)*
0742:20	ELM FD	And Ithaca you got all the lights up and everything for him
	ITH TWR	Everythings full up
	ELM FD	And you got the equipment standing by?
	ITH TWR	Yes everybody is here
	ELM FD	Okay
0742:31	ELM AR/DR	Empire one forty-one the emergency equipment is standing by at Ithaca, airport lights are full bright. Do you have the airport yet sir?
0742:40	EMP 141	We have the localizer, negative airport, Empire one forty-one

Agencies Making Transmissions

Transmission

0742:45 ELM AR/DR

Okay do you have your DME on to help to check your distance from Ithaca?

0742:50 EMP 141

We do and showing eleven on the DME, we're at twenty-two hundred

ELM AR/DR

Roger

0743:50 ELM AR/DR

And Ithaca, Elmira

0743:55 ITH TWR

Ithaca

ELM AR/DR

I don't know if you're listening on the frequency or not did you hear him he said he's on the localizer he shows eleven miles now.

ITH TWR

Okay, thank you much

0744:00 ELM AR/DR

He had ground contact but I don't have any radar with him

ITH TWR

Alright and he didn't say anything what the problem was?

ELM AR/DR

It's one flap down

ITH TWR

Oh, one flap down, alright thanks

0744:40 ELM AR/DR

And Empire one forty-one how you doing now still on the localizer?

EMP 141

Okay we're on the localizer and we're at nineteen hundred, nine miles airport

0744:50 ELM AR/DR

One forty-one, roger, everything reasonably under control at this point?

0744:55 EMP 141

(Not too bad we've just we're all the way listing to the, you know full aileron to the right just to maintain our heading, it's kinda tough to get back on the localizer)*

Agencies Making Transmissions

Transmission

0745:05 ELM AR/DR

Okay-the emergency equipment is standing by. Is there further, any way, assistance we can be to you?

0745:05 ELM 141

Naw thats just fine nope

1247:20 ELM AR/DR

Empire one forty-one the winds are reported right now at three hundred degrees at eighteen with gusts to twenty-five and its holding pretty steady like that. I'll give you late wind check after you pick up the airport.

0747:29 EMP 141

(rog)*

0748:35 ELM AR/DR

You don't see him do you Ithaca?

ITH TWR

No I don't see him yet

ELM AR/DR

He didn't answer me on this last call

ITH TWR

No I don't have any contact with him

0748:55 ELM AR/DR

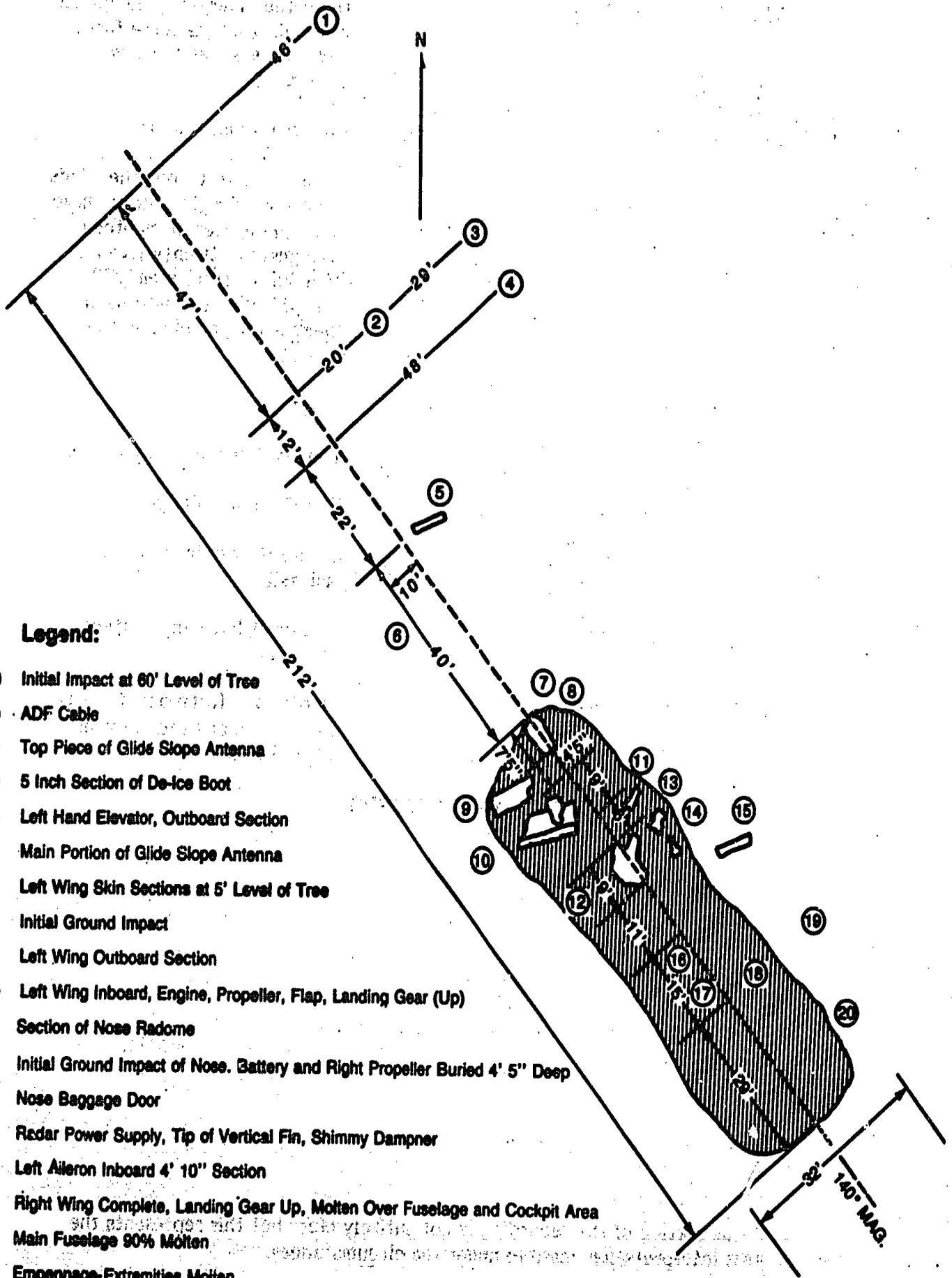
Empire one forty-one if you're able to respond tell me your DME please

END OF TRANSCRIPT

*This portion of the recording is not entirely clear but this represents the best interpretation possible under the circumstances.

APPENDIX E

WRUCKAGE DISTRIBUTION CHART



Legend:

- ① Initial Impact at 60' Level of Tree
- ② ADF Cable
- ③ Top Piece of Glide Slope Antenna
- ④ 5 Inch Section of De-Ice Boot
- ⑤ Left Hand Elevator, Outboard Section
- ⑥ Main Portion of Glide Slope Antenna
- ⑦ Left Wing Skin Sections at 5' Level of Tree
- ⑧ Initial Ground Impact
- ⑨ Left Wing Outboard Section
- ⑩ Left Wing Inboard, Engine, Propeller, Flap, Landing Gear (Up)
- ⑪ Section of Nose Radome
- ⑫ Initial Ground Impact of Nose. Battery and Right Propeller Buried 4' 5" Deep
- ⑬ Nose Baggage Door
- ⑭ Radar Power Supply, Tip of Vertical Fin, Shimmy Dampner
- ⑮ Left Aileron Inboard 4' 10" Section
- ⑯ Right Wing Complete, Landing Gear Up, Molted Over Fuselage and Cockpit Area
- ⑰ Main Fuselage 90% Molted
- ⑱ Empennage-Extremities Molted
- ⑲ Emergency Exit Window-Unburned
- ⑳ Fire Zone-Ground Scorch Marks

APPENDIX F
SERVICE BULLETIN NO. 739



SERVICE No. 739
BULLETIN

Piper Aircraft Corporation

Lock Haven, Pennsylvania, U.S.A.

FAA Approved

March 1, 1982 M

Subject: Restriction of Flap Travel and Inspection
of Wing Flap Flexible Drive Shaft

Models Affected: Serial Numbers Affected:

PA-31-300 Navajo, PA-31 Navajo	31-2 through 31-7812129
PA-31-325 Navajo C/R	31-5001 through 31-7852171
PA-31-350 Chieftain	31P-1 through 31P-7790012
PA-31P Pressurized Navajo	

Compliance Time:

- PART I:** Within the next twenty-five (25) hours of operation.
PART II: Within the next one hundred (100) hours of operation or at the next scheduled inspection interval or Programmed Inspection Event, whichever occurs first, and at each five hundred (500) hours of operation thereafter subsequent to initial compliance with this Service Release.
PART III: On or before August 1, 1982.

Purpose: Recent field reports have been received indicating flap system malfunctions which were the result of failures of the wing flap flexible shaft assemblies. Should such a failure occur, an asymmetric ("split flap") condition could result. An asymmetric flap condition in excess of 25° flap extension could result in loss of lateral control.

Recent Flight Test evaluations have demonstrated that restriction of flap travel to 25° will allow the aircraft to be controllable should a full, split flap condition occur.

This Service Bulletin provides instructions in three (3) PARTS as follows:

PART I
Restricts the use of full flaps to 25°, requires installation of temporary placards and incorporation of hand written Pilot's Operating Handbook/AFM revision until compliance with PART III of this Service Bulletin is completed.

PART II
Includes detailed instructions for inspection of the wing flap flexible shaft assemblies.

(over)

Service Bulletin No. 739

Page 2 of 21

Purpose: (continued)**PART III**

Announces the appropriate Piper Kits which provide instructions, placards, and hardware for positive restriction of flap travel, and incorporates information regarding permanent Pilot's Operating Handbook/AFM revisions.

NOTES:

1. For PA-31-300 Navajo, PA-31 Navajo, PA-31-325 Navajo C/R, PA-31-350 Chieftain
It has been demonstrated that restricting flap travel to 25° will not result in increased full flap stall speeds or landing distances as presently published in the Performance section of the Pilot's Operating Handbook/AFM for these airplanes.
2. For PA-31P Navajo
Restriction of flap travel to 25° will result in an increase of approximately 10% to the landing distances and an increase of full flap stall speeds as presently published in the Pilot's Operating Handbook/AFM for the affected airplanes.

PART I
Instructions:

1. Verify rigging and adjustment of flap position sender as described in the Surface Controls section (Chapter 5) of the appropriate Service Manual.
2. Lower flaps to the 25° position.

NOTE: Remove excess play by lifting the flap trailing edge and obtain an angle measurement using a propeller protractor.

3. Paint a red full flap radial position mark to correspond with the needle position at 25° on the flap position indicator lens. Also, extend a white slippage mark from the indicator case to the lens. (Ref. Sketch A.)
4. Attach the appropriate Flap Operation Placard on the left window molding in plain view of the pilot. (Ref. Sketch B.)
5. For PA-31P aircraft attach appropriate Stall Speed Placard(s) adjacent to the airspeed indicator(s). (Ref. Sketch C.)
6. Make the necessary handwritten changes in pen and ink to the appropriate Airplane Flight Manual/Pilot's Operating Manual/Pilot's Operating Handbook as follows:
 - (a) For Piper Model PA-31-300:
 - (i) Approved Airplane Flight Manual per PAC Report No. 1470 for Model PA-31-300, Serial Nos. 31-2 through 31-511.

Page 1c. Log of Revisions. Add: Interim Revision 20
IAW Piper Service Bulletin 739.

Page 6a. Subparagraph M - Placards
Add the following Placards:
On Pilot's left window moulding:
- Flap settings in excess of 25° are not approved.
- Disengage the aircraft autopilot prior to operating flaps.
- Operate flap control in small increments to assure flap symmetry.

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Instructions: (continued)

6. (a) continued

Page 15 Paragraph 13 - Before Landing
f. Wing flaps - as required (in Steps) - Extend at
less than 150 mph. (maximum extension -25°)

Page 21a. Paragraph 15 - Asymmetric Flap Condition
Delete: Existing Asymmetric Flap Condition Procedures

- Add: Split Flaps (0° to 25°)
- (1) Flap Switch - OFF
 - (2) Aileron - Maintain Wings Level
 - (3) Airspeed - 120 mph
 - (4) Flap Switch - UP (to obtain symmetric flaps)
- NOTE: If flap symmetry cannot be obtained, then ---
- (5) Flap Switch - OFF
 - (6) Flap Control Circuit Breaker --- Pull
 - (7) Land as soon as possible at nearest suitable airport.

(b) For Piper Model PA-31:

(1) Approved Airplane Flight Manual per PAC Report 1362 for Model PA-31, Serial Nos 31-2 through 31-659, 31-661 through 31-771.

Page 1f. Log of Revisions. Add: Interim Revision 32 (IAW) Piper Service Bulletin 739.

Page 6a. Subparagraph M - Placards
Add the following placard:
On Pilot's left window moulding:
"- Flap settings in excess of 25° are not approved.
- Disengage the aircraft autopilot prior to operating flaps.
- Operate flap control in small increments to assure flap symmetry."

Page 16 Paragraph 14 - Before Landing
f. Wing flaps - as required (in steps) - Extend at
less than 150 mph maximum extension -25°.

Page 21a. Paragraph 16 - Asymmetric Flap Condition
Delete: Existing Asymmetric Flap Condition Procedures

- Add: Split Flaps (0° to 25°)
- (1) Flap switch - OFF
 - (2) Aileron - Maintain wings level
 - (3) Airspeed - 120 mph
 - (4) Flap Switch - UP (to obtain symmetric flaps)
- NOTE: If flap symmetry cannot be obtained, then ---
- (5) Flap Switch - OFF
 - (6) Flap Control Circuit Breaker -- Pull
 - (7) Land as soon as possible at nearest suitable airport.

(over)

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Instructions: (continued)

6. b. (ii) Approved Airplane Flight Manual per PAC Report No. 1655 for Model PA-31 without nacelle wing lockers and with T10-540-A2C engines Nos. 31-712 through 31-751.

Page 2a. Log of Revisions. Add: Interim Revision 13
IAW Piper Service Bulletin 739.

Page 8 Subparagraph M - Placards
Add the following placard:

On pilot's window moulding:

" - Flap settings in excess of 25° are not approved.

- Disengage the aircraft autopilot prior to operating flaps.

- Operate flap control in small increments to assure flap symmetry."

Page 19 Paragraph 14 - Before Landing

f. Wing flaps - as required (in steps) - Extend at
less than 150 mph (maximum extension -25°).

Page 26 Paragraph 16 - Asymmetric Flap Condition

Delete: Existing Asymmetric Flap Condition procedures.

Add: Split Flaps (0° to 25°)

(1) Flap switch - OFF

(2) Aileron - maintain wings level

(3) Airspeed - 120mph

(4) Flap switch - UP (to obtain symmetric flaps)

NOTE: If flap symmetry cannot be obtained, then ---

(5) Flap switch - OFF

(6) Flap control Circuit Breaker - PULL

(7) Land as soon as possible at nearest suitable airport.

- (iii) Approved Airplane Flight Manual per PAC Report No. 1686 for Model PA-31 with nacelle wing lockers and with T10-540-A2C engines, Serial Nos. 31-712 through 31-751.

Page 2a. Log of Revisions. Add: Interim

Revision 11 IAW Piper Service Bulletin 739.

Page 8 Subparagraph M - Placards

Add the following placard:

On pilot's left window moulding:

" - Flap settings in excess of 25° are not approved.

- Disengage the aircraft autopilot prior to operating flaps.

- Operate flap control in small increments to assure flap
symmetry."

Page 19 Paragraph 14 - Before Landing

f. Wing flaps - as required (in steps) - Extend at
less than 150 mph (maximum extension -25°).

Service Bulletin No. 739

Page 5 of 21

Instructions: (continued)

6. b. (iii) continued

Page 26 Paragraph 16 - Asymmetric Flap Condition
Delete: Existing Asymmetric Flap Condition Procedures

Add: Split Flaps (0° to 25°)

- (1) Flap Switch - OFF
- (2) Aileron - maintain wings level
- (3) Airspeed - 120 mph
- (4) Flap switch - UP (to obtain symmetric flaps)

NOTE: If flap symmetry cannot be obtained, then ---

- (5) Flap Switch - OFF
- (6) Flap Control Circuit Breaker -- Pull
- (7) Land as soon as possible at nearest suitable airport.

(iv) Approved Airplane Flight Manual per PAC Report No. 1702 for model PA-31, Serial Nos. 31-752 through 31-7612110.

Page 2f. Log of Revisions. Add: Interim Revision 23 IAW Piper Service Bulletin 739

Page 8a. Subparagraph M - Piccards

Add the following placard:

On pilot's left window moulding:

- " - Flap settings in excess of 25° are not approved.
- Disengage the aircraft autopilot prior to operating flaps.
- Operate flap control in small increments to assure flap symmetry."

Page 19 Paragraph 13 - Before Landing

f. Wing flaps - as required (in steps) - Extend at less than 150 mph (maximum extension -25°).

Page 26d. Paragraph 15 - Asymmetric Flap Condition

Delete: Existing Asymmetric Flap Condition Procedures

Add: Split Flaps (0° to 25°)

- (1) Flap switch - OFF
- (2) Aileron - maintain wings level
- (3) Airspeed - 120 mph
- (4) Flap switch - UP (to obtain symmetric flaps)

NOTE: If flap symmetry cannot be obtained, then ---

- (5) Flap switch - OFF
- (6) Flap control Circuit Breaker -- PULL
- (7) Land as soon as possible at nearest suitable airport.

(v) Approved Pilot's Operating Handbook per PAC Report No. 2045 for Model PA-31, Serial Nos. 31-7712001 through 31-7812129.

Page iv-j. Log of Revisions. Add: Interim Revision 11 IAW Piper Service Bulletin 739.

(over)

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Instructions: (continued)

6. b. (v) continued

- Page 2-1 Paragraph 2.3 Airspeed Limitations
Maximum Flap Extended Speed (Vfe)
Do not exceed this speed with a given flap setting.
Delete: 25° flap and related airspeeds.
Delete: 40° flap and related airspeeds.
Add: 25° flap 130 KCAS 140 KIAS
- Page 2-14 Paragraph 2.27 - Placards
Add the following placard:
On pilot's left window moulding:
"- Flap settings in excess of 25° are not approved.
- Disengage the aircraft autopilot prior to operating flaps.
- Operate flap control in small increments to assure flap symmetry."
- Page 3-7 Asymmetric Flap Condition (Ser. Nos. 31-7712001 through 31-7812129)
Delete: Existing Asymmetric Flap Condition procedure
Add: Split Flaps (0° to 25°)
Flap Switch -----OFF
Aileron -----Maintain Wings Level
Airspeed -----100 KIAS
Flaps Switch --- UP (to obtain symmetric flaps)
NOTE: If flap symmetry cannot be obtained, then ---
Flap Switch ---- OFF
Flap Control Circuit Breaker ----PULL
Land as soon as possible at nearest suitable airport.
- Page 3-20 Paragraph 3.39 - Asymmetric Flap Condition (Serial No. 31-7712001 through 31-7812129)
Delete the fourth paragraph.
- Page 4-1 Paragraph 4.3-Airspeed for Safe Operation
(d) Maximum Flap Extended Speeds
Delete: 25° Flaps and related airspeeds
Delete: Full Flaps (40°) 140 KIAS
Add: 25° Flaps 140 KIAS
- Page 4-8 Before Landing (Checklist)
Wing Flaps
Delete: (174 KIAS max. 25° s/n 31-7812001 and up)
Delete: (140 KIAS max. 40°)
Add: (140 KIAS max. 25°)
- Page 4-16 Paragraph 4.29 Before Landing
Fourth Subparagraph.
Change: "Maximum speed for 40° flap extension is 140 KIAS."
to "Maximum speed for 25° flap extension is 140 KIAS."
Delete: Last sentence

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Page 7 of 21

Instructions: (continued)

6. c. For Piper Model PA-31-325

(i) Approved Airplane Flight Manual per PAC Report No. 1860 for Model PA-31-325, Serial Nos. 31-730093 through 31-7612110.

Page 3-viii. Log of Revisions. Add: Interim Revision 12
IAW Piper Service Bulletin 739.

Page 3-7 Subparagraph M - Placards
Add the following placard:

On pilot's left window moulding:

" - Flap settings in excess of 25° are not approved.

- Disengage the aircraft autopilot prior to operating flaps.

- Operate flap control in small increments to assure flap symmetry."

Page 3-21 Paragraph 13 - Before Landing

1. Wing Flaps - as required (in steps) - extend at less than 150 mph.

(Maximum extension -25°).

Page 3-30a Paragraph 17- Asymmetric Flap Extension

Delete: Existing Asymmetric Flap Condition Procedure.

Add: Split Flaps (0° to 25°)

(1) Flap Switch - OFF

(2) Aileron - Maintain Wings Level

(3) Airspeed - 115 MPH CAS

(4) Flap Switch - UP (to obtain symmetric flaps).

NOTE: If symmetric flaps cannot be obtained, then ---

(5) Flap Switch - OFF

(6) Flap Control Circuit Breaker --- PULL

(7) Land as soon as possible at nearest suitable airport.

(ii) Approved Pilots Operating Handbook per PAC Report No. 1964 for Model PA-31-325, Serial Nos. 31-7712001 through 31-7812129.

Page iv-j. Log of Revisions. Add: Interim Revision 10
IAW Piper Service Bulletin 739.

Page 2-1 Paragraph 2.3 Airspeed Limitations

Maximum Flaps Extended Speed (Vfe) -

Do not exceed this speed with a given flap setting.

Delete: 25° flap and related airspeeds.

Delete: 40° flap and related airspeeds.

Add: 25° flap 130 KCAS 127 KIAS.

(over)

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Page 8 of 21

Instructions: (continued)

6. c. (1) continued

Page 2-14

Paragraph 2.22 - Placards

Add the following placard:

On pilot's left window moulding"

" - Flap settings in excess of 25° are not approved.

- Disengage the aircraft autopilot prior to operating flaps.

- Operate flap control in small increments to assemble flap symmetry."

Page 3-7

Asymmetric Flap Condition (Ser Nos. 31-7712001 through 31-7812129)

Delete: Existing Asymmetric Flap Condition procedures.

Add: Split Flaps (0° to 25°)

Flap Switch ----- OFF

Aileron ----- Maintain Wings Level

Airspeed ----- 100 KIAS

Flap Switch ----- UP (to obtain symmetric flaps)

NOTE: If symmetric flaps cannot be obtained, then ---

Flap Switch ----- OFF

Flap Control Circuit Breaker --- PULL

Land as soon as possible at nearest suitable airport.

Page 3-20

Paragraph 3-39

Asymmetric Flap Condition

Delete the fourth Subparagraph.

Page 4-1

Paragraph 4.3 - Airspeed for Safe Operation

(d) Maximum Flaps Extended Speeds

Delete: 25° Flaps and related airspeeds

Delete: Full Flaps (40°) 127 KIAS

Add: 25° Flaps 127 KIAS

Page 4-8

Before Landing (Checklist)

Wing Flaps

Delete: (158 KIAS max 25°, s/n 31-7812001 and up)

Delete: (127 KIAS Max. 40°)

Add: (127 KIAS Max. 25°)

Page 4-16

Paragraph 4.29 Before Landing

Fourth Subparagraph

Change: "The maximum speed for 40° flap extension is

127 KIAS" to "The maximum speed for 25° flap

extension is 127 KIAS".

Delete: Last sentence

d. For Piper Model PA-31-350(1) Approved Airplane Flight Manual per PAC Report No. 1750 for Model PA-31-350, Serial Nos. 31-5001 through 31-7652177.

Page 3-xiv. Log of Revisions. Add: Interim Revision 20 IAW Piper Service Bulletin 739.

(over)

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Instructions: (continued)

6. d. (i) continued
Page 3-2

Paragraph G. Airspeed Limitations

Delete: Flaps Extended Speed (40°) and related airspeeds.

Add: Flaps Extended Speed (25°) 150 MPH 130 Kts.

Page 3-8

Subparagraph M - Placards

Add the following Placard:

On pilot's left window moulding:

- Flap settings in excess of 25° are not approved.
- Disengage the aircraft autopilot prior to operating flaps.
- Operate flap control in small increments to assure flap symmetry."

Page 3-20

Paragraph 13 - Before Landing

f. Wing flaps - as required (in steps) - Extend to 15° at less than 175 mph, 15° to 25° at less than 150 mph (130 kts).

Maximum Extension - 25°.

Page 3-27b.

Paragraph 16 - Asymmetric Flap Condition

Delete: Existing Asymmetric Flap Condition Procedure

Add: Split Flaps (0° to 25°)

- (1) Flap switch - Off
 - (2) Aileron - Maintain Wings level
 - (3) Airspeed - 120 mph
 - (4) Flap Switch - UP (to obtain symmetric flaps)
- NOTE: If flap symmetry cannot be obtained, then ---
- (5) Flap Switch - OFF
 - (6) Flap Control Circuit Breaker --- PULL
 - (7) Land as soon as possible at nearest suitable airport.

(ii) Approved Pilot's Operating Handbook per PAC Report No. 2046 for Model PA-31-350, Serial Nos. 31-7752001 through 31-7852171.

Page iv-j

Log of Revisions. Add: Interim Revision 11

IAW Piper Service Bulletin 739.

Page 2-1

Paragraph 2.3 Airspeed Limitations

Maximum Flaps Extended Speed (Vfe)

Do not exceed this speed with a given flap setting.

Delete: 25° Flap and related airspeeds.

Delete: 40° Flap and related airspeeds.

Add: 25° Flap 130 KCAS 132 KIAS

(over)

Service Bulletin No. 739

Page 10 of 21

Instructions: (continued)

6. d. (ii) continued

Page 2-14

Paragraph 2.27 Placards

Add the following placard:

On pilot's left window moulding:

- " - Flap settings in excess of 25° are not approved.
- Disengage the aircraft autopilot prior to operating flaps.
- Operate flap control in small increments to assure flap symmetry."

Page 3-7

Asymmetric Flap Condition (Ser Nos. 31-7752001 through 31-7852171)

Delete: Existing Asymmetric Flap Condition Procedures

Add: Split Flaps (0° to 25°)

Flap Switch----- OFF

Aileron----- Maintain Wings Level

Airspeed----- 100 KIAS

Flap Switch -----UP (to obtain symmetric flaps)

NOTE: If flaps symmetry cannot be obtained, then ---

Flap Switch ----- OFF

Flap Control Circuit Breaker --- PULL

Land as soon as possible at nearest suitable airport.

Page 3-20

Paragraph 3.39 Asymmetric Flap

Condition (Serial No. 31-7752001 through 31-7852171)

Delete the fourth Subparagraph.

Page 4-1

Paragraph 4.3 - Airspeed for Safe Operation

(d) Maximum Flaps Extended Speeds

Delete: 25° flaps and related airspeeds

Delete: Full Flaps (40°) 132 KIAS

Add: Full Flaps (25°) 132 KIAS

Page 4-8

Before Landing (Checklist)

Wing Flaps

Delete: (132 KIAS max 40°) and (162 KIAS max 25°)

Add: (132 KIAS max 25°)

Page 4-16

Paragraph 4.29 - Before Landing

Fourth subparagraph

Delete: "Maximum speed for 40° flap extension is 132 KIAS."

e. For Piper Model PA-31P(i) Approved Airplane Flight Manual per PAC Report No. 1615 for Model PA-31P, Serial Nos. 31P-1 through 31P-7630019.

Page 2f

or 2g

Log of Revisions. Add: Interim

Revision 26 IAW Piper Service Bulletin 739.

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Page 11 of 21

Instructions: (continued)

6. e. continued

- Page 4 Subparagraph H - Airspeed Limitations and Indicator.
Stall Speed Changed to Read:
Stall Speed 25° Flaps, Gear Down, Power Off,
(7800 lbs.) 86 MPH (75 KT)
- Page 5 Subparagraph H - Airspeed Limitations and Indicator
markings
Add the following placard adjacent to airspeed indicator:
Stall speed 86 mph/75 KI with 25° Flaps.
- Page 8 Subparagraph M - Placards
Add the following placard:
On pilot's side window moulding:
"Flap settings in excess of 25° are not approved.
Operate flap control in small increments to assure flap
symmetry. Increase landing distance by 10% with the
use of 25° flaps. Approach speed 120 MPH (112 KT).
No flap selection with autopilot engaged."
- Page 8a Under Flap Indicator White Arc add:
Radial Ref Line at 25°
- Page 19 Paragraph 13 - Before Landing
Change i to read:
i. Wing flaps - as required (in steps) -
Extend at less than 150 mph maximum extension -25°.
- Page 32a Paragraph 18 - Asymmetric Flap Condition
Delete: Subparagraph a. and b.
Add: New paragraph a. as follows:
a. Split Flaps (0° to 25°)
(1) Flap Switch - OFF
(2) Aileron - maintain wings level
(3) Airspeed - 133 mph
(4) Flap Switch - opposite direction
(Try to obtain symmetric flaps)
(5) Land as soon as possible at nearest
suitable airport.

3.) Approved Pilots Operating Handbook per PAC Report No. 2047 for
Model PA-31P, Serial Nos. 31P-7730001 and up.

- Page iv-b. Log of Revisions. Add: Interim Revision 4 IAW Piper
Service Bulletin 739.
- Page 2-2 Paragraph 2.3 - Airspeed Limitations
Stall Speed: Stall speed changes to read:
Gear Down and 25° flaps (7800 lbs.)
75 KCAS 76 KIAS
Paragraph 2.5 - Airspeed Indicator Markings add the
following placard adjacent to airspeed indicator:
"Stall Speed 75 KCAS/76 KIAS
with 25° Flaps."

(over)

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Instructions: (continued)

6. e. (ii) continued
- Page 2-3 Under (a) White Arc --- add:
"Red Radial Line @ 25°"
- Page 2-9 Paragraph 2.27 - Wing Flaps Limitations
Change (b) to read as follows and add (c):
(b) Landing 25°
(c) No flap selection with autopilot engaged.
- Page 2-14 Paragraph 2-33 - Placards
Add the following placard:
On pilot's side window moulding:
"Flap settings in excess of 25° are not approved.
Operate flap control in small increments to assure flap
symmetry. Increase landing distance by 10% with use of
25° flaps. Approach speed 112 KIAS. No flap selection
with autopilot engaged."
Page 3-7 Paragraph 3.3 - Emergency Checklist -
Asymmetric Flap Condition
Delete: Split Flaps (0° and 15° or 15° and 40°) and
associated instructions.
Replace with the following:
Split Flaps (0° to 25°)
Flap Switch ----- OFF
Aileron ----- Maintain wing level
Airspeed ----- 115 KIAS
Flap Switch ----- Opposite direction
(Try to obtain symmetric flaps)
Land as soon as possible at nearest suitable airport.
- Page 3-8 Delete: Subparagraph SPLIT FLAPS (0° and 30° or 0° and 40°)
- Page 3-20 Delete Paragraph 3.41
- Page 4-8 Paragraph 4.5 - Normal Procedures Checklist - Before Landing
Flaps changed to read:
Flaps (extend in steps at less than 126 KIAS,
Maximum extension -25°) as required.
- Page 4-17 Paragraph 4.29 - Before Landing
In last sentence of third paragraph change
40° to 25°
- Page 5-40 Delete Figure 5-55
- Page 7-14 Paragraph 7.17 - Flight Control System
Revise:
(b) First sentence to read:
"Extend the flaps in small increments
to assure flap symmetry."
(c) First sentence to read:
"Retract the flaps in small increments
to assure flap symmetry."

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Instructions: (continued)

7. Log compliance with Service Bulletin No. 739, PART I, in the Aircraft Logbook.

NOTE: Permanent revisions to the respective airplane Flight Manuals, Pilot's Operating Manuals and Pilot's Operating Handbooks for affected aircraft are in preparation as of the release date of this Service Bulletin. Upon completion, the revisions will be supplied through normal mailing procedures. Receipt and incorporation of these revisions will supersede the handwritten changes given in PART I, above.

PART II

Instructions:

1. Gain access to flap motor, Piper Part Number 475 208 and flexible shaft assemblies, (drive shaft), Piper Part Number 486 597, as outlined in the Surface Controls section (Chapter 5) of the appropriate Navajo/Chieftain/Pressurized Navajo Service Manual.
2. Remove all Ty-Raps and support clamps along the entire length of both flexible shaft assemblies, and inspect the outer housing. If the housing is damaged, replace the flexible shaft assembly.
3. Disconnect flexible shafts and remove the flap motor. Using caution not to damage the flexible shaft housing, route the flexible shafts outboard through the longitudinal beams (Ref Sketch D).

NOTE: Do not disconnect flexible shaft from transmission at this time.

4. Visually inspect the flexible shaft splined drive coupling and retaining pin for evidence of looseness on the cable swage fitting. (Ref Sketch D, Figure 2.) If any looseness is apparent, replace the flexible shaft assembly.
5. Inspect the swaged fittings at both ends of the flexible shaft as follows:
 - a. Expose the swaged portion of the inner cable at the motor end by twisting the outer housing two (2) turns clockwise. The swaged portion of the cable should have eight (8) flats clearly visible and free from deep scratches or wear marks. (Ref Sketch D, Figure 2.)
 - b. Using a micrometer, or dial caliper, measure the diameter of the swage for each of the flats at the middle of the swaged portion of the cable. A total of four (4) measurements should be taken. If any of the measurements exceed .247 inches, replace the drive shaft.
 - c. Disconnect drive shaft from the flap transmission. Using caution not to damage the shaft housing, route inboard through the Sta. 87.50 bulkhead. (ref Sketch E.) Inspect the swaged portion of the drive blade fitting end as described in "a" and "b" above.
 - d. Inspect the drive blade dimension as shown in Sketch E, Figure 4.

(over)

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Instructions: (continued)

6. Inspect the internal splines of the drive coupling for evidence of wear. If splines are distorted or significantly worn, replace the drive shaft. Use the following method to determine if the amount of spline wear is acceptable.
 - a. Twist a piece of .032 safety wire around the swaged fitting at the motor end of the drive shaft to form a pointer (Ref Sketch F, Figure 5). With one end of the flap motor armature shaft secured engage the opposite end into the flexible shaft spline.
 - b. Hold the spline end of the flexible shaft securely with one hand, and gently turn the flap motor to remove rotational play in the splines. Place a reference mark on the motor housing adjacent to the wire pointer (Ref Sketch F, Figure 5). Turn the flap motor gently in the opposite direction to remove rotational play and place another reference mark on the motor housing. If any distance between these two marks exceed $5/32$ of an inch (4 mm) replace the flexible shaft assembly (Ref Sketch F, Figure 5).
 7. While holding the transmission end of the drive shaft stationary, twist the motor end one (1) turn clockwise and release. Inspect for evidence of movement between the inner cable and the swaged fittings at both ends. Turn cable one (1) turn counter-clockwise and repeat inspection. (Ref Sketch D, E.) If movement or separation between the inner cable and the swage fitting is apparent, replace the flexible shaft assembly.
- NOTE:** If pliers or similar tool is used to twist cable, wrap cable ends with tape or a cloth to prevent damage.
8. Determine that the inner cable moves freely within the housing, and may be turned easily by hand. If there is any snagging or binding the cable must be replaced.
 9. Reassembly of the flap system:
 - a. Ascertain that the flap motor shaft is centered within the motor adapter housing (Ref Sketch F, Figure 6.).
 - b. Lubricate both ends of the flexible shafts with MIL-G-23827 grease.
 - c. Reassemble and verify flap system rigging as outlined in the Surface Controls section (Chapter 5) of the appropriate Service Manual.
 10. Reinstall floorboards and access panels.
 11. Log compliance with Piper Service Bulletin No. 739, PART II, in the Aircraft Logbook.

Material Required: If required by inspection, one (1) or two (2) each per aircraft Flexible Drive Shaft Assembly, Piper Part Number 486 597.

 PART III

Instructions:

1. Install appropriate Piper Kit as follows:
 - a. For PA-31 and PA-31-300 Navajos, PA-31-325 Navajo C/R, and PA-31-350 Chieftain install Flap Travel Restriction and Placard Kit, Piper Part Number 764 396.
 - b. For PA-31P Pressurized Navajo, install Flap Travel Restriction and Placard Kit, Piper Part Number 764 397.

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Material Required:

<u>Model</u>	<u>Part Number</u>	<u>Nomenclature</u>
PA-31, PA-31-300		
PA-31-325, PA-31-350	764 396	Kit - Flap Travel Restriction
PA-31P	764 397	Kit - Flap Travel Restriction

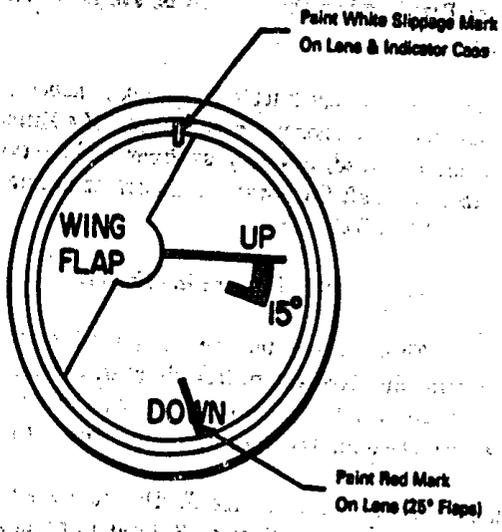
Availability of Parts: Piper Kits Part Numbers 764 396, 764 397 and Flexible Shaft Assemblies Piper Part Number 486 597 will be available from your Piper Field Service Facility on or before April 12, 1982.

NOTE: Upon release, Permanent Pilot's Operating Handbook/AFM Revisions will be mailed through normal procedures. If additional copies of revisions are required, advise your Piper Field Service Facility or contact Piper Aircraft Corporation, Customer Service Sales, Lock Haven, PA 17745, USA.

Effectivity Date: This Service Release is effective upon receipt.

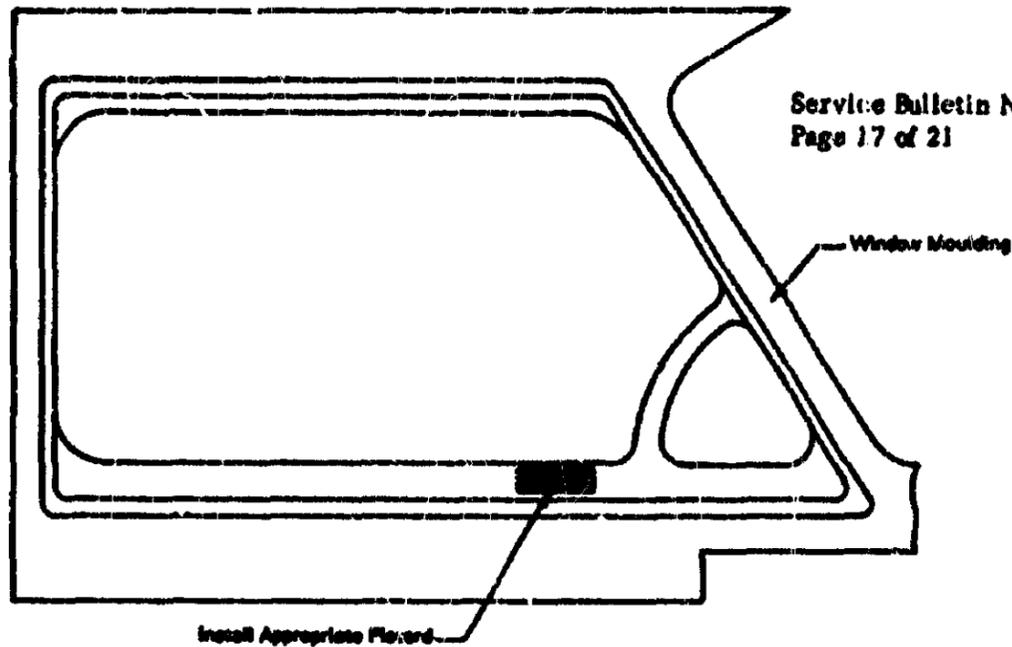
Summary: This Service Release was issued to provide detailed instructions for inspecting the flap system flexible shaft assemblies, and to announce the restriction of flap travel limits. This does not supercede the requirements of Service Bulletin 494B, as revised, and Service Letter 764A, as revised.

Please contact your local Piper Field Service Facility to make arrangements for compliance with the provisions of this Service Release in accordance with Compliance Time, above.



TYPICAL FLAP INDICATOR

SKETCH A



Typical Left Pilot's Window Moulding

.....

FLAP SETTINGS IN EXCESS OF 25° ARE NOT APPROVED. DISENGAGE THE AIRCRAFT AUTOPILOT PRIOR TO OPERATING FLAPS. OPERATE FLAP CONTROL IN SMALL INCREMENTS TO ASSURE FLAP SYMMETRY. 71834-2

FOR: PA-31-300, PA-31 NAVAJO, PA-31-326 NAVAJO C/R, PA-31-300 CHEETAH
Cut Out And Attach Placard P/N 71834-2 To Pilot's Window Moulding
As Shown In Sketch Above.

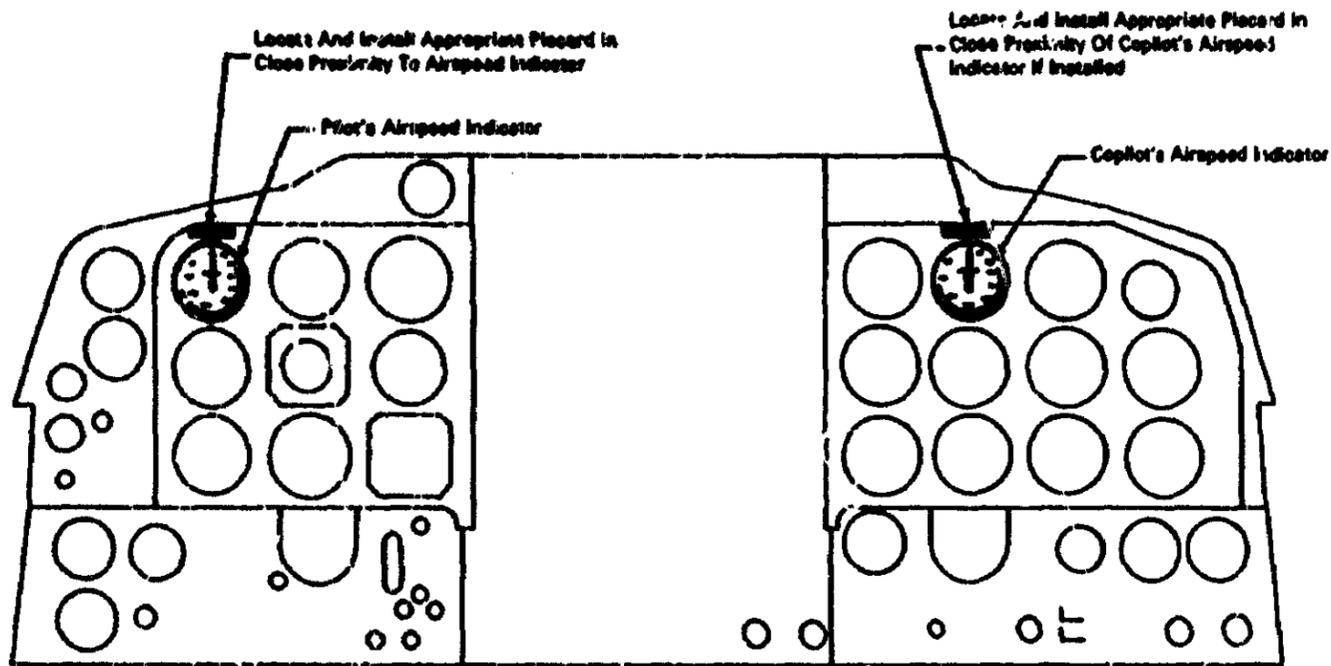
.....

FLAP SETTINGS IN EXCESS OF 25° ARE NOT APPROVED. OPERATE FLAP CONTROL IN SMALL INCREMENTS TO ASSURE FLAP SYMMETRY. INCREASE LANDING DISTANCE BY 10% WITH THE USE OF 25° FLAPS. APPROACH SPEED 129 MPH (112 KT). NO FLAP SELECTION WITH AUTOPILOT ENGAGED. 71859-2

FOR: PA-31P PRESSURIZED NAVAJO
Cut Out And Attach Placard P/N 71859-2 To Pilot's Window Moulding
As Shown In Sketch Above.

.....

SKETCH B



PA-31F INSTRUMENT PANEL

**STALL SPEED 86 MPH/76 KT
WITH 25° FLAPS** 81008-2

**STALL SPEED 86 MPH/76 KT
WITH 25° FLAPS** 81008-2

For PA-31F Pressurized Navajo With Serial Nos. 31P-1 To 31P-7630018 Incl.

Cut Out And Attach Placard(s) P/N 81008-2 In Close Proximity To Airspeed Indicator(s) As Shown Above.

**STALL SPEED 75 KCAS/76 KIAS
WITH 25° FLAPS** 81007-2

**STALL SPEED 75 KCAS/76 KIAS
WITH 25° FLAPS** 81007-2

For PA-31F Pressurized Navajo With Serial Nos. 31P-7730001 And Up

Cut Out And Attach Placard(s) P/N 81007-2 To Instrument Panel In Close Proximity To Airspeed Indicator(s) As Shown Above.

SKETCH C

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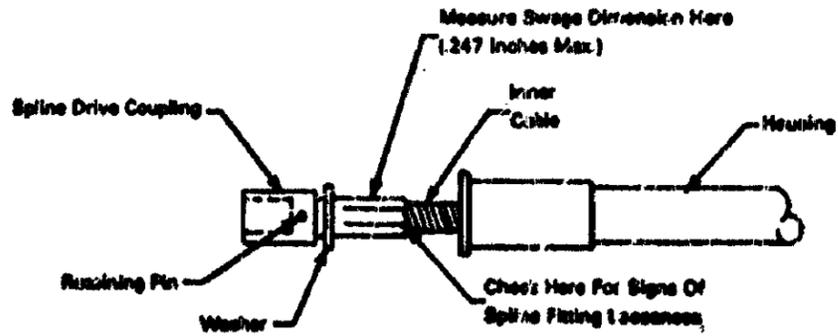


FIGURE 2

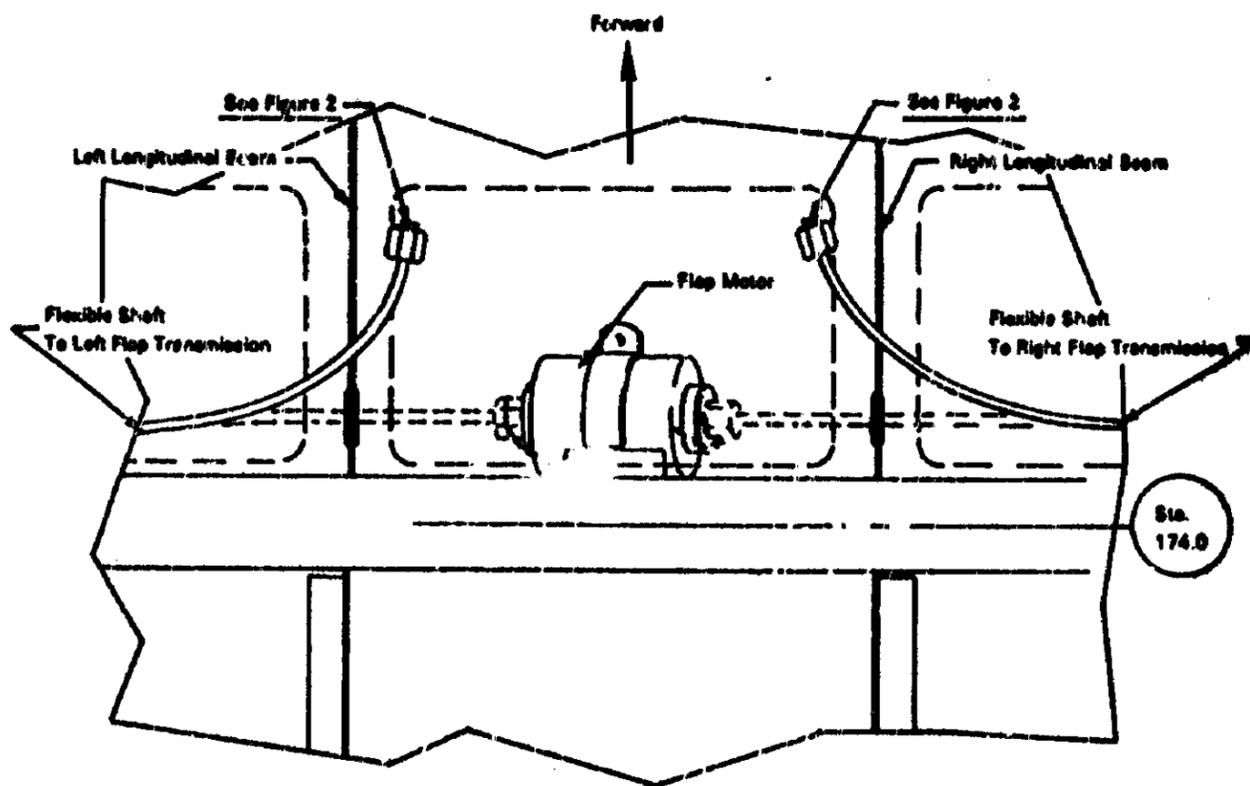


FIGURE 1

SKETCH D

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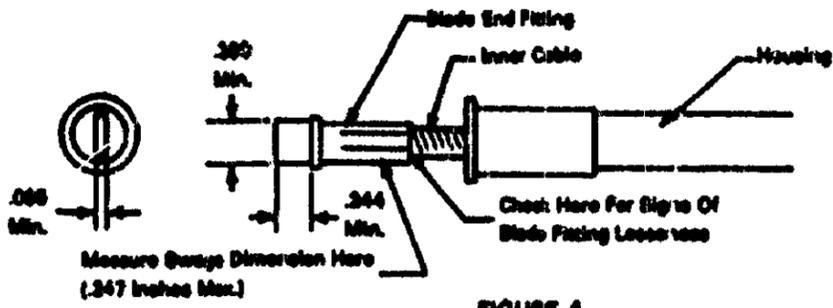


FIGURE 4

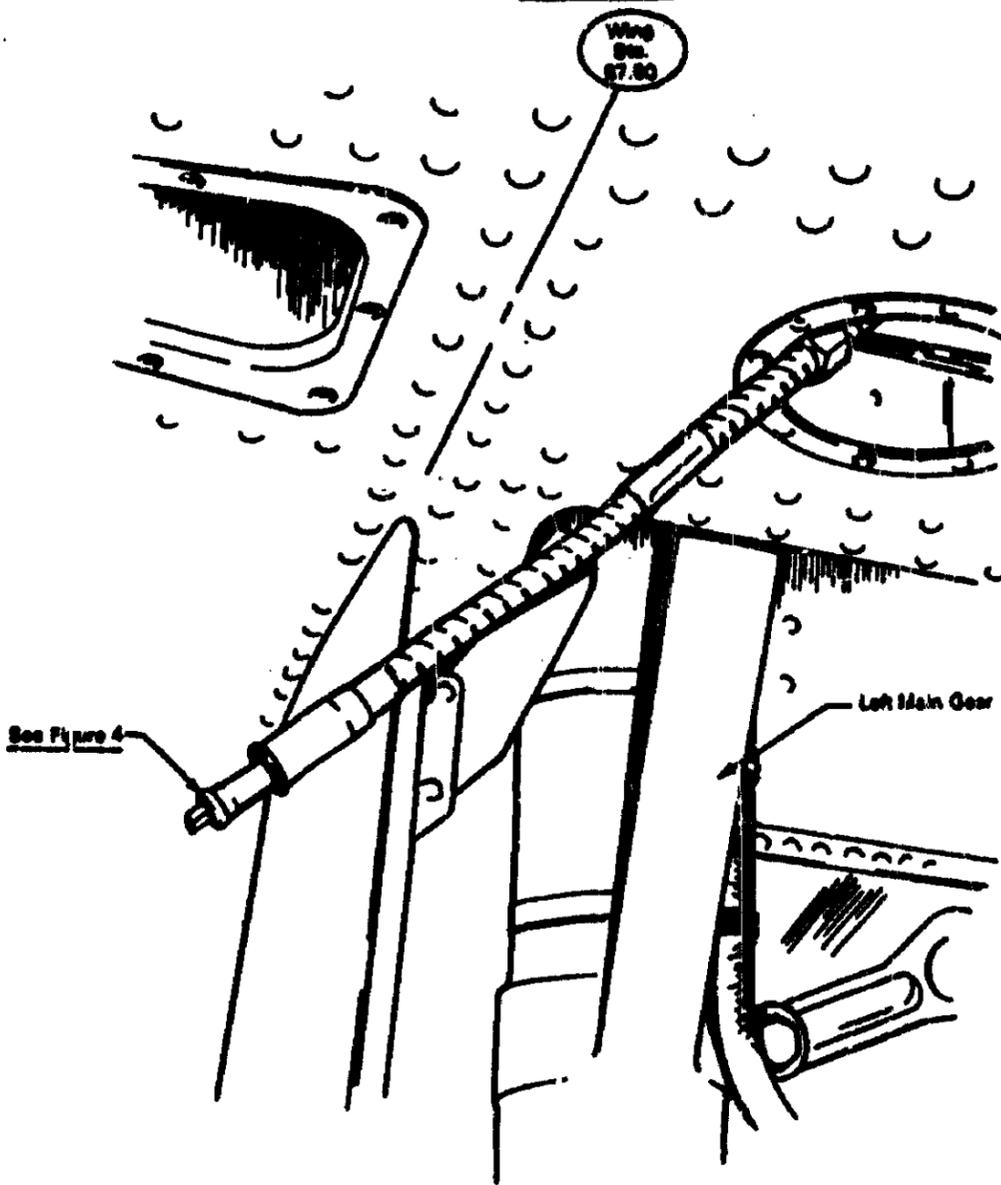


FIGURE 3
Left Wing Shown - Right Wing Opposite

SKETCH E

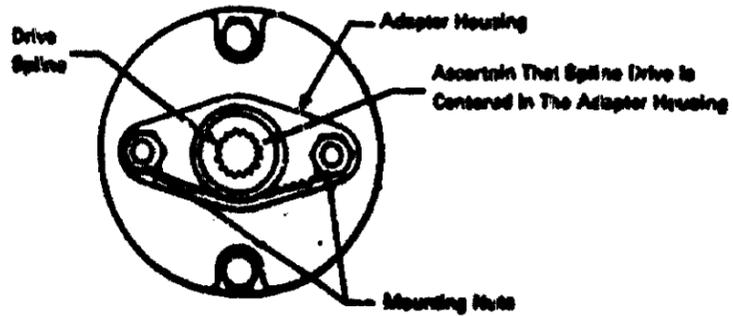


FIGURE 9

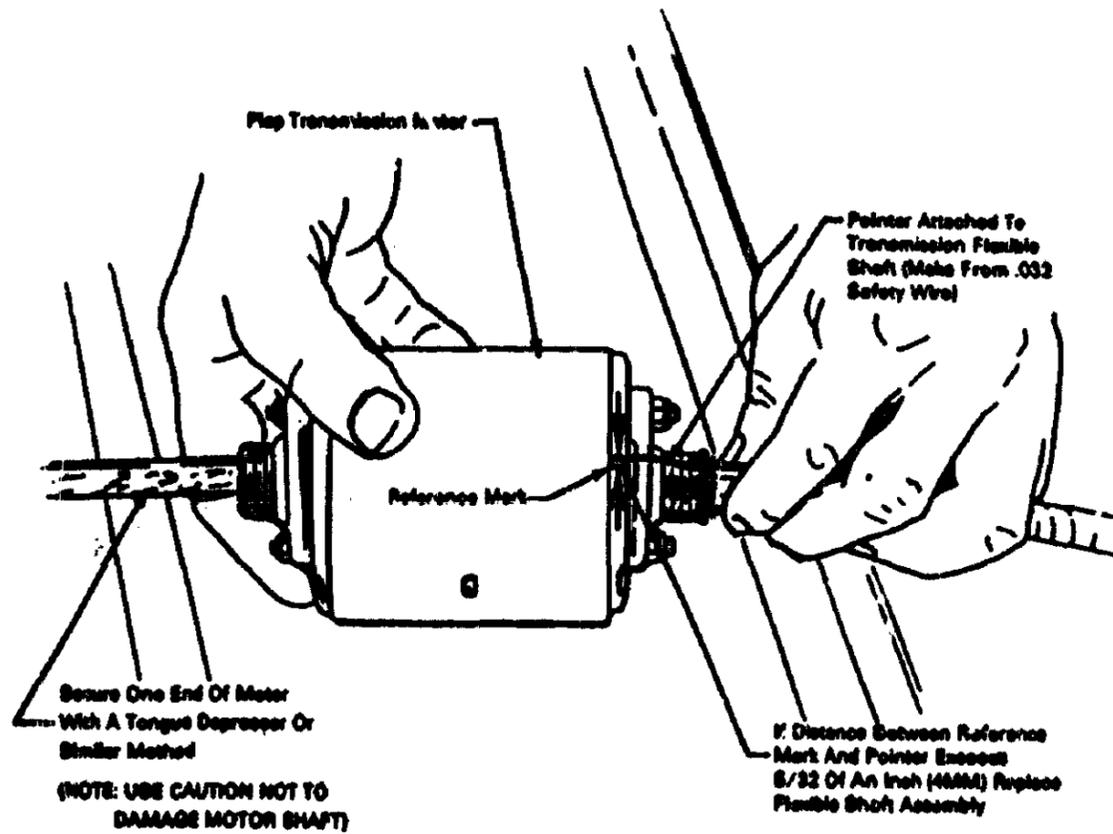


FIGURE 8

SKETCH F

**APPENDIX G
PIPER AIRWORTHINESS DIRECTIVE**

PIPER

Airworthiness Directive

Volume I

82-08-06 **PIPER AIRCRAFT CORPORATION:** Amendment 39-4368. Applies to Models PA-31 (S/Ns 31-2 thru 31-7812129), PA-31-300 (S/Ns 31-2 thru 31-511), PA-31-325 (S/Ns 31-7300932 thru 31-7812129), PA-31-350 (S/Ns 31-5001 thru 31-7852171), PA-31T (S/Ns 31T-7400002 thru 31T-7820092, except 31T-7820067), PA-31T1 (S/Ns 31T-7804001 thru 31T-7804011) and PA-31P (S/Ns 31P-1 thru 31P-7730012) airplanes certificated in any category.

COMPLIANCE: Required as indicated, unless already accomplished.

To prevent loss of control due to flap asymmetric conditions caused by failure of the flap extension system, accomplish the following:

a) On Models PA-31 (S/Ns 31-2 thru 31-7812129), PA-31-300 (S/Ns 31-2 thru 31-511), PA-31-325 (S/Ns 31-7300932 thru 31-7812129), PA-31-350 (S/Ns 31-5001 thru 31-7852171) and PA-31P (S/Ns 31P-1 thru 31P-7730012) airplanes.

1. Within 25 hours time-in-service after the effective date of this AD, restrict maximum flap extension to 25 degrees by installation of temporary instrument markings and placards and incorporation of pen and ink changes in the applicable "Airplane Flight Manuals" or "Pilot's Operating Handbook and FAA Approved Flight Manual" in accordance with Part I of Piper Service Bulletin No. 739, dated March 1, 1982. The installation of permanent kits prescribed in paragraph a)4 below meets these requirements.

2. Within 100 hours time-in-service after the effective date of this AD, and thereafter at intervals not exceeding 500 hours time-in-service, inspect the flap flexible drive shaft assemblies for alignment, wear and security of attachment of end fittings to the flexible shaft. Replace unsatisfactory parts in accordance with Part II of Piper Service Bulletin No. 739, dated March 1, 1982.

3. Within the next 100 hours time-in-service after the effective date of this AD or when last accomplished under AD 76-10-06 or AD 81-11-03 and thereafter at intervals not exceeding 100 hours time-in-service, inspect the wing flap transmission for excessive wear. Rework or replace this assembly as necessary in accordance with "Instructions No. 1" of Piper Service Bulletin 494B dated July 17, 1979.

4. On or before August 1, 1982, install Piper Flap Travel Restrictions and Placard Kit, P/N 764 396 in Model PA-31, PA-31-300, PA-31-325 and PA-31-350 airplanes and P/N 764 397 in Model PA-31P airplanes.

b) On Model PA-31T (S/Ns 31T-7400002 thru 31T-7520013) airplanes:

1. Within 25 hours time-in-service after the effective date of this AD, restrict maximum flap extension to 15 degrees by installation of temporary instrument markings and placards and incorporation of pen and ink changes in the

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"Pilot's Operating Handbook and FAA Approved Airplane Flight Manual" in accordance with Part I of Piper Service Bulletin No. 741, dated March 1, 1982. The installation of permanent placards and manual revisions prescribed by paragraph b)4 below meets this requirement.

2. Within the next 100 hours time-in-service after the effective date of this AD and thereafter at intervals not exceeding 500 hours time-in-service, inspect the flap flexible drive shaft assemblies for alignment, wear and security of attachment of end fittings to the flexible shaft. Replace unsatisfactory parts in accordance with Part I B, Piper Service Bulletin No. 741, dated March 1, 1982.

3. Within the next 100 hours time-in-service after the effective date of this AD or since last accomplished under AD 76-10-06 or AD 81-11-03 and thereafter at intervals not to exceed 100 hours time-in-service, inspect the wing flap transmission for excessive wear. Rework or replace this assembly as necessary in accordance with "Instructions No. 1" of Piper Service Bulletin No. 494B, dated July 17, 1979.

4. On or before August 1, 1982, install a permanent Autopilot/Flap Operation Placard, Piper P/N 81009-02 and permanent "Pilot's Operating Handbook and FAA Approved Airplane Flight Manual" revisions incorporating the same information specified in paragraph b)1.

5. Upon installation of Piper Kit 764-398, Wing Flap Transmission Modification Kit, the restrictions and inspections required by paragraphs b)1 and 2 are no longer required and temporary markings and manual revisions may be removed and the requirements of paragraph c) below become applicable.

c) On Model PA-31T (S/Ns 31T-7520014 thru 31T-7820066, 31T-7820068 thru 31T-7820092) and those airplanes having S/N 31T-7400002 thru 31T-7520013 if Piper Kit 764 398 is installed and Model PA-31T1 (S/Ns 31T-7804001 thru 31T-7804011) airplanes:

1. Within the next 25 hours time-in-service after the effective date of this AD, install a Temporary Autopilot/Flap Operating Placard and make temporary changes in the "Airplane Flight Manual" or "Pilot's Operating Handbook and FAA Approved Airplane Flight Manual" in accordance with Part II of Piper Service Bulletin No. 741, dated March 1, 1982. The installation of a permanent placard and manual revisions prescribed by paragraph c)3 below meets these requirements.

2. Within the next 100 hours time-in-service after the effective date of this AD, or when last accomplished under AD 76-10-06 or AD 81-11-03 and thereafter at intervals not exceeding 100 hours time-in-service, inspect the wing flap transmission for excessive wear. Rework or replace this assembly as necessary in accordance with "Instructions No. 1" of Piper Service Bulletin 494B, dated July 17, 1979.

3. On or before August 1, 1982, install a permanent Autopilot/Flap Operation Placard, Piper P/N 81109-02 and permanent "Pilot's Operating Handbook and FAA Approved Flight Manual" revisions incorporating the same information specified in paragraph c)1.

d) Upon submission of substantiating data by an owner or operator, through an FAA Maintenance Inspector, the Chief, Atlanta Aircraft Certification Office, FAA, may adjust the inspection intervals and compliance times specified in this AD.

e) An equivalent method of compliance with this AD when used must be approved by the Chief, Atlanta Aircraft Certification Office, FAA, P.O. Box 20636, Atlanta, Georgia 30320.

NOTE: In the event replacement flexible drive shafts are not available for the PA-31, PA-31-300, PA-31-325 and PA-31-350 airplanes, the airplane may be operated with flaps secured in the full-up position provided appropriate performance data is used.

This Amendment 39-4368 supersedes ADs 76-10-06 (Amendment 39-2613) and 81-11-03 (Amendment 39-4113).

This Amendment 39-4368 becomes effective April 22, 1982.

FOR FURTHER INFORMATION CONTACT:

W. H. Trammell, ACE-130A, Atlanta Aircraft Certification Office, FAA, P.O. Box 20636, Atlanta, Georgia 30320; telephone (404) 763-7781.